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ABSTRACT

This resource paper is designed to supplement undergraduate college geography courses at the introductory and advanced level; it is intended for the use of both the student and instructor. Two perspectives are discussed: the nature of individual movement behavior and the consequences of large numbers of moves for change in neighborhood characteristics. Part I is concerned with the decision-making processes of individual households for which two distinct stages are recognized: the decision to seek a new residence and the search for a new dwelling. In the first stage, factors affecting the decision to move are identified with particular attention focused on movement as a response to stresses of the local environment. In the second stage, the interaction between the household's awareness of the characteristics of the urban area and the location of available opportunities is stressed. Part II treats aggregate properties of residential mobility with emphasis on the implications of particular patterns of movement for neighborhood change. A model for examining mobility in large North American cities is developed in hopes of answering questions relating to the rate of population turnover and the change in neighborhood population composition. Figures, tables, and sources of the data for mobility studies are included. (Author/JK)

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RESIDENTIAL MOBILITY IN THE CITY

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FOREWORD

The Resource Papers have been developed as expository documents for the use of both the student and instructor. They are experimental in that they are designed to supplement existing texts and to fill a gap between significant research in geography and readily accessible materials. The papers are concerned with important concepts in modern geography and focus on three general themes: geography theory; policy implications; and contemporary social relevance. They are designed as supplements to a variety of undergraduate college geography courses at the introductory and advanced level. These Resource Papers are developed, printed, and distributed by the Commission on College Geography under the auspices of the Association of American Geographers with National Science Foundation support. The ideas presented in these papers do not necessarily imply endorsement by the AAG. Single copies are mailed free of charge to all AAG members.

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INTRODUCTION

Changes of residence occur hundreds of times every day in every major city. The move from one dwelling to another is a basic means by which change occurs both in the daily patterns of individual activities and in the characteristics of neighborhoods throughout the city.

For the individual, changing residence is the most important mechanism for adjusting housing and neighborhood experience to meet changing family needs and desires. Even if no other factors entered the picture, most people would move three or four times during their lives when they leave home, marry and experience the changing needs of a growing family. However, superimposed on these demographic events are many other situations which give rise to residential moves. Changes in the individual's physical and social environment and in his financial status are all capable of generating moves, and an understanding of the nature and effectiveness of these various pressures is important in evaluating the consequences of many public and private decisions within the city.

The decision to leave the old residence is but one part of the process. Finding a new dwelling is equally important. To accomplish this task, the individual must search for opportunities which satisfy certain personal criteria and then he must express preferences between those opportunities he encounters. Contained within this simple observation is much that is of interest. How is search organized? It is evident that the searcher will utilize whatever knowledge he has of the city in organizing his activities; to the extent that his knowledge of the residential characteristics of different areas incorporates spatial biases and distortions, these will be reflected in his search. The outcome of this process also depends on the location of opportunities which satisfy his personal criteria. For some the opportunities are numerous and widely spread, but for others, especially the poor, there may be little choice either in dwelling type or in location within the city.

Study of individual changes of residence provides many insights into the ways in which the broader urban structure constrains individual behavior. However, if we focus our attention at a different scale we can see that these same changes of residence also modify that broader structure. It is the relocation of large numbers of households with varying characteristics which provides the basic mechanism for change in the composition of neighborhoods. The move of the growing family to the suburb, the arrival of the rural migrant in the inner city, and the inflows and outflows associated with ethnic or racial change all have important implications for the study of the internal structure of the city. An understanding of the processes which generate these flows and an evaluation of the net outcome of flow and counter-flow provide an essential input to the development of dynamic models of urban structure.

The very magnitude of population flows within the city is such that it is useful to establish some framework for studying their characteristics. In the United States, approximately 20% of the population change their dwelling every year. Over a longer period of time, although many moves are attributable to a small and highly mobile segment of the community, over 50% of the population change their place of residence at least once in six years. Some degree of residential mobility is a basic and persistent attribute of virtually all urban neighborhoods.

The majority of studies of population movement have concerned themselves with intercounty or interstate migration, yet, as Figure 1 shows, this type of move is but the tip of the iceberg. When all changes of residence are considered, residential mobility is seen to be a highly localized phenomenon with just over 60% of all moves being less than five miles in length (Butler et al., 1969). Thus, residential moves are the immediate cause of changes in the composition and character of many urban neighborhoods, and the impetus for change is more often derived from the inflow of households from adjacent neighborhoods rather than from distant places.

The discussion in this Resource Paper reflects these two perspectives, namely the nature of individual movement behavior and the consequences of large numbers of moves for change in neighborhood characteristics. Part I is concerned with the decision-making processes of individual households for which two distinct stages are recognized: the decision to seek a new residence and the search for a new dwelling. With respect to the first stage, factors affecting the decision to move are identified with particular attention being focussed on movement as a response to

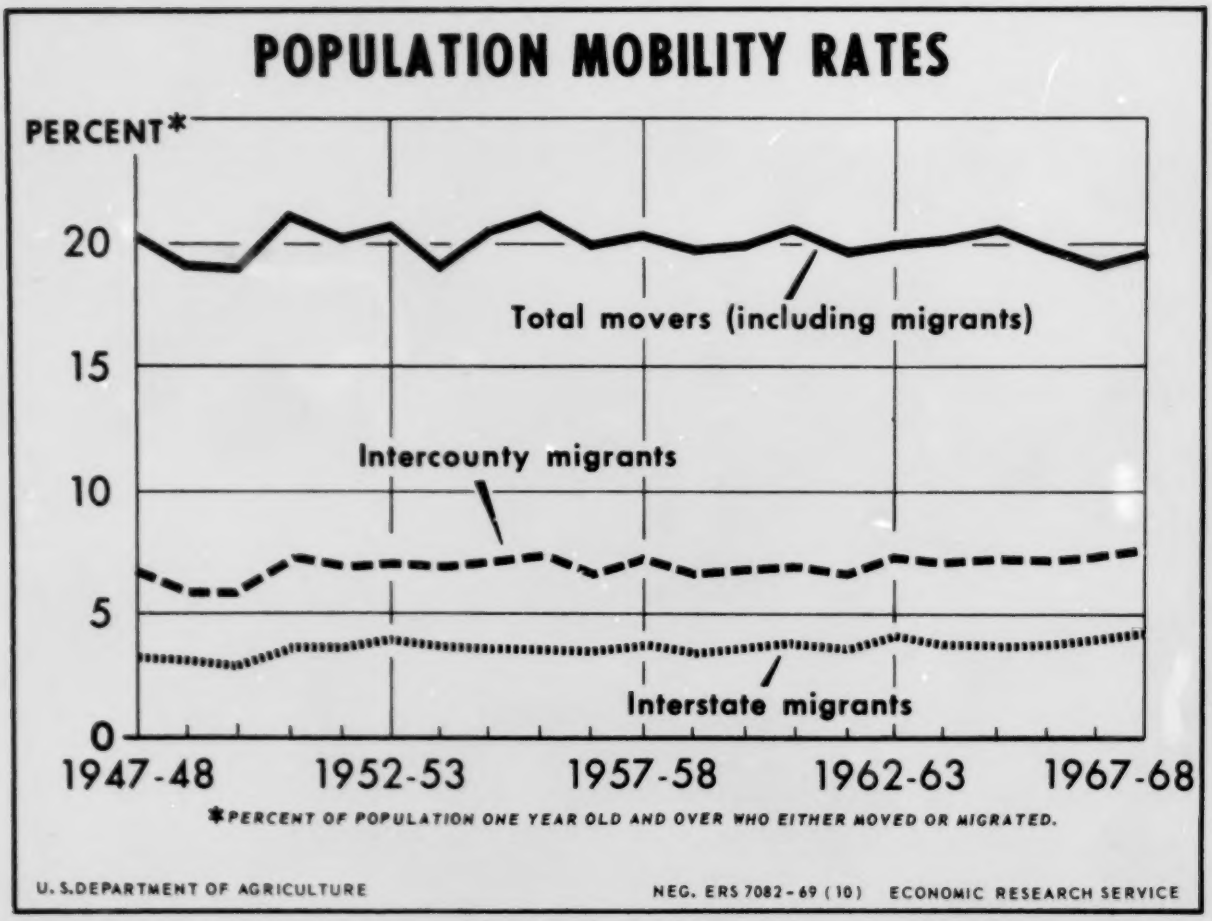

Figure 1. Components of Population Mobility in The United States 1947-1968 Source: U.S. Department of Agriculture (1969)

stresses imposed by the local environment. For the second stage, the interaction between the household's awareness of the characteristics of the urban area and the location of available opportunities is of major interest.

Part II treats aggregate properties of residential mobility with emphasis on the implications of particular patterns of movement for neighborhood change. A substantial part of the discussion is concerned with how the multitude of individual moves can be represented within a model such that specific questions relating to the rate of population turnover and the change in composition of neighborhood populations can be answered.

Both residential choice behavior and the nature of change in the residential structure of cities are topics of much current research activity. It is hoped that this paper will give some idea of the types of questions that are being asked as well as an indication of the results that have been obtained.

PART I. MOBILITY BEHAVIOR OF INDIVIDUALS

Our interest in individual changes of residence stems from two sources. First, individual migration behavior is an excellent example of the process of making complex locational decisions when the amount of information available is limited. Examination of the structure of this process provides insights into a number of problems of geographical interest ranging from aspects of shopping behavior to the relocation of industrial establishments. Second, the substantial amount of empirical data relating to individual changes of residence provides an essential background to discussing the role of residential mobility in understanding neighborhood structure and change.

We first define what we mean by an individual. If we take it to mean a single person we encounter difficulties in that the majority of single person moves are *dependent*, in the sense that they move because they are tied to some other person who is motivated to move. We therefore define the individual to be the *basic decision-making unit*, which in most practical circumstances is the *household*. When one individual splits from an existing household and relocates by himself, it is convenient to regard this event as the creation of a new single-person household. In our subsequent discussion the terms individual and household will be used interchangeably unless otherwise stated.

If we consider the series of events associated with each change of residence, it is readily evident that a number of different actors are involved. Although the household occupies the center of the stage, the actions of individuals and groups such as friends and acquaintances, real estate agents, land developers, financial institutions, and particularly urban planners and politicians, influence the outcome of the individual decision by providing limits on the range of attainable opportunities. Research has focussed almost exclusively on the household itself and often forgets that individual actions are constrained by higher level decisions made by planners, politicians, and other groups who are responsible for many of the larger scale aspects of city growth and development.

Recently, some interest has been shown in the effect of the location of the household's acquaintances on its patterns of search for a new dwelling (Brown and Holmes, 1970) and in the impact of residential developer decisions on the distribution of dwelling opportunities (Kaiser and Weiss, 1970). However, substantial research gaps still exist, particularly with regard to the influence on movement patterns of zoning controls, mortgage policy, and the behavior of owners and managers of property in selecting new residents. Our discussion reflects these biases in existing research, but it is important to retain a broader perspective on the factors affecting individual behavior.

Residence changes occur for many reasons. They serve a variety of functions for different people, and any attempt to represent a specific experience as "typical" would be futile. Our task is to identify the various conditions under which moves take place and the factors which influence their outcome. To do this, it is convenient to consider the household's movement behavior to focus on two main decisions:

A. the decision to seek a new residence,
B. the search for and selection of a new residence.

This two-stage division is consistent with the approach adopted in several recent studies (for example: Arminger, 1966; Brown and Moore, 1970; Butler, et al., 1969; and Wolpert, 1965).

A. The Decision to Seek a New Residence [1]

The main focus of attention in this section is the identification of the reasons why particular households choose to look for somewhere else to live. However, before considering specific factors influencing the household's decision to seek a new residence, we introduce a number of concepts basic to a discussion of decision-making. First, we assume that each individual possesses a set of *values* regarding personal life style, housing conditions, and neighborhood characteristics. Although these values may be regarded as unmeasurable for our purposes as they are both generalized and highly personal to the individual, their existence permits the individual to perform three operations:

(1) to provide a set of specific *expectations* regarding the attributes of the dwelling in which he is to live. The

[1] Several of the ideas in the following section were developed in discussion with Stephen Gale.

expectations specify the level of each attribute, such as size of dwelling, which is deemed acceptable to that individual.

(2) to provide a *valuation* of the dwelling in which he now lives. This valuation is based not only on such factors as the physical condition of the dwelling, the number of rooms and the size of the yard, but also on accessibility to shops, playgrounds and schools, the degree of industrial pollution, and the characteristics of the neighborhood population: in geographic terms it includes both the site and the situational characteristics of the dwelling. (The valuation of this site-situation complex for a specific dwelling is referred to as *place utility* by Wolpert, 1965.)

(3) to provide valuations of specific alternatives among housing opportunities such that a *preference ordering* of such opportunities can be made. This preference ordering provides a basis for applying a rule of choice.

With reference to these three operations we can regard the decision to seek a new residence as being motivated in four ways.

(a) The decision to seek a new residence is imposed directly on the household, i.e., no choice is open to the household. This situation occurs in most urban renewal situations and in some cases of eviction in which the evictee can perform no voluntary action (such as paying the rent) to reverse the decision to evict.

(b) Particular situations arise which directly affect the household and so reduce the valuation of the present residence that a move is almost inevitable. Included in this category are moves motivated by marriage, divorce, death in the family, long-distance job changes, and sudden reductions or increases in the financial status of the household.

(c) Changes in housing needs or the deterioration of certain aspects of the dwelling environment lead to a lowered valuation of the existing dwelling but the reduction is of a smaller magnitude than in (b). However, the downward re-evaluation is still sufficiently large that a move is contemplated. Pressures on living space arising from an addition to the family are a typical source of such re-evaluations. This type of situation, which is essentially a response to a set of *push* factors, is perhaps the most common source of motivation for the decision to seek a new residence.

(d) Awareness of attainable housing opportunities with noticeably higher valuations than the existing dwelling may stimulate the decision to seek a new residence by raising expectations relative to the valuation of the existing dwelling. The attractions of alternatives, referred to as *pull* factors, are most evident in situations such as the attraction of prestigious suburbs for the young executive.

In the literature it has been standard procedure to group the first two categories into *forced moves*, which are then ignored in subsequent discussion of decision-making processes (Rossi, 1955, Butler et al., 1969); the remainder are treated as *voluntary moves* in which a moving choice situation apparently exists. However, in many cases the differences between the moves generated by category (b) and categories (c) and (d) are those of degree rather than of kind. Table 1 shows a breakdown of moves into forced and voluntary categories as defined by Rossi (1955): the forced moves form a highly significant part of the total, yet little is known about their locational characteristics (a study of the distribution of evictions might prove most interesting). Finally, we note that the sources of motivation are not mutually exclusive; in particular, the push factors of category (c) frequently operate in conjunction with the pull factors of category (d).

The existence of a valuation of the present dwelling which falls below the individual's expectations or the awareness of attainable opportunities at other locations with higher valuations are not in themselves sufficient to guarantee a decision to seek a new residence. Two types of situation are considered. First, there is the possibility of increasing the valuation of the existing residence by a positive action; these may range from an improvement of the site characteristics by efforts such as adding a room, installing air conditioning, or redecorating the house, to an adjustment of situational attributes by the purchase of a second car or exerting pressure on the city council to

TABLE 1: A CLASSIFICATION OF RECENT MOVES

	*% of Total**
Free Choice Moves	61
Forced Moves – Total	39
Comprising	
(1) Involuntary Moves (evictions, dwelling destruction, severe income loss)	23
(2) Intercity Migration	8
(3) Previous occupancy arranged on temporary basis	4
(4) Newly married	3
(5) Other (mainly recently divorced)	1

*100% equals 444 recorded moves.

Source: Rossi (1955) p. 135.

repave the street. Knowledge of the effectiveness of these actions could be important to public officials in developing planning strategies; for example, the ability of home improvement subsidies to reduce mobility rates for given sub-populations might provide an argument for promoting such subsidies. At present, little is known of the extent to which home improvements are a genuine substitute for a change of residence, but the question promises to be a fruitful area of study.

Second, a number of factors associated with the individual's economic and social ties to the present dwelling act as inertial forces in the decision to seek a new residence. The possession of many friends in the neighborhood, familiarity with local shopkeepers, and the very fact of ownership of a dwelling all provide extra bonds between household and dwelling. The effort of breaking these ties imposes an additional cost on the household; the implication is that the level of dissatisfaction or the degree of attraction from alternatives must be sufficiently high to overcome these inertial forces.

Because of the nature of research undertaken to date, the following discussion is confined to the factors affecting *voluntary movers* as we defined them above. Figure 2 indicates the elements to be discussed.

We first consider the dominant factors motivating the decision to seek a new residence: these are presented in terms of (a) negative reactions or dissatisfactions with the present dwelling and (b) positive attractions of alternate locations. The nature of inertial factors is then examined and, finally, the implications of these findings for interpretation of several frequently observed correlations between population characteristics and the propensity to move are discussed.

1. Motivating Forces Underlying the Decision to Seek a New Residence

(a) Negative reactions to the present dwelling and its environment

(i) *Dwelling Space:* Since Rossi's classic study in Philadelphia (Rossi, 1955), almost every interview study concerned with mobility has reported that complaints regarding dwelling conditions, particularly the available living space, are the major source of dissatisfaction with the present residence.[2] This

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[2] At this point it is useful to examine the meaning of a statement such as "variable X (for example, the age of the head of the household) is significantly related to the decision to move." Practically, it most often means that the distribution of variable X for a group of movers is statistically different from the distribution of variable X for a group of non-movers. For a large population sample, however, the *apparent* differences in distribution need not be large. For example, in the hypothetical case shown in the left-hand table below, there is a significant association between race and movement response in that 50% of the movers are non-whites whereas only 37.5% of non-movers are non-white. In the right-hand table, which at first sight does not appear too different, there is no difference in the proportionate distributions of non-whites between movers and non-movers, and there is no evidence to indicate a relationship between race and movement response.

	(I)			(II)		
	Non-white	White	Total	Non-white	White	Total
Movers	100	100	200	80	120	200
Non-movers	300	500	800	320	480	800
Total	400	600	1000	400	600	1000

It is perhaps as important to realize what the statement does *not* mean. In particular, it does not mean that the majority of movers possess characteristic X nor that the majority of people who possess

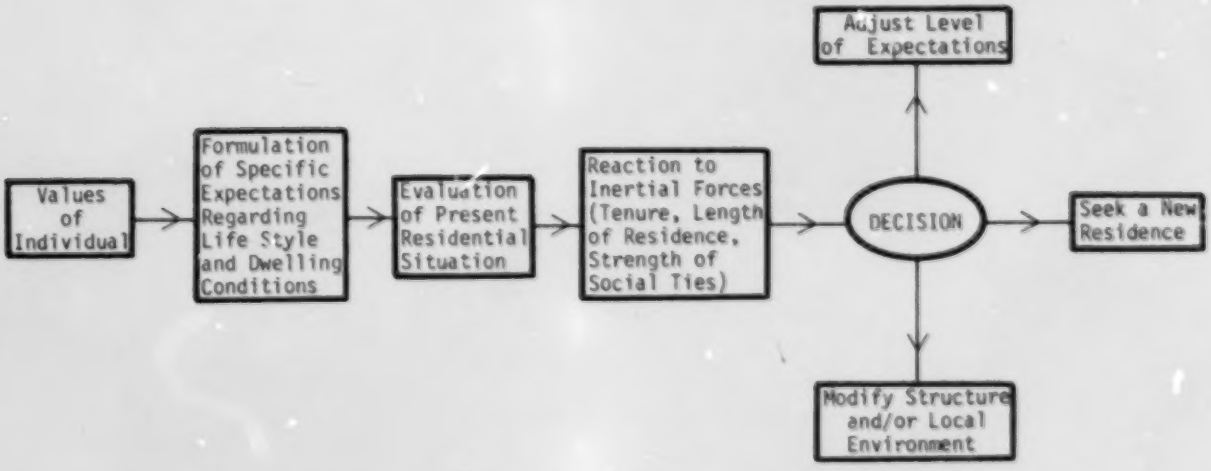

Adjust Level of Expectations
Values of Individual
Formulation of Specific Expectations Regarding Life Style and Dwelling Conditions
Evaluation of Present Residential Situation
Reaction to Inertial Forces (Tenure, Length of Residence, Strength of Social Ties)
DECISION
Seek a New Residence
Modify Structure and/or Local Environment

Figure 2. Elements Considered in Decision-Making Process of Voluntary Movers

reaction occurs at both ends of the family life cycle, with the growing family reacting to too little space and the dwindling family to too much. However, although 51% of the movers in Rossi's study cited complaints about living space as contributing to movement desires (44% gave it as a primary reason), the reaction appears to be more a function of individual perception of the sufficiency of the dwelling space rather than of any objective measure of that space. Table 2 shows that the predominant association is between size of family and movement desires and that the additional effect of the size of dwelling in terms of number of rooms is rather small. If it is true that perception of sufficiency of living space is the major factor in generating complaints, then much research needs to be done regarding individual responses to specific amounts and arrangements of living space. The results of such a study would have obvious implications for improved design of residential units.

the characteristic *X* move. Finally, and most importantly, we cannot impute a causal relation from this type of analysis. In other words, we cannot infer that a deliberate change in the value of the variable *X* (for example, a restoration program aimed at raising housing quality in specific neighborhoods) will result in a given reduction or increase in the number of moves: in order to do this, more detailed analyses of the antecedents of movement response are required.

TABLE 2: THE RELATION BETWEEN HOUSEHOLD SIZE, DWELLING UNIT SIZE, AND MOBILITY INCLINATIONS FOR A SAMPLE OF RENTERS

Size of Dwelling \ *Household Size*	*One Person*	*Two Person*	*Three Person*	*Four + Person*
1–2½ Rooms	28* (65)	52 (59)	80 (10)	
3–3½ Rooms		66 (64)		83 (34)
4 Rooms	33 (24)		75 (36)	
		56 (57)		
> 4 Rooms			72 (22)	81 (42)

*Unbracketed figure is the % of those interviewed who wish to move. Bracketed figure is the total number interviewed in that category. Cell heights relate to range of dwelling unit sizes at left.

Source: Adapted from Rossi (1955) p. 78.

(Saarinen, 1969, provides some discussion of studies at this scale.)

(ii) *Housing Costs:* Although of significance for a few families, the overall effect of housing costs on movement desires appears to be weaker than might have been anticipated. It seldom registers as one of the major complaints, although this is less true for renters than for owners. In fact, Lansing et al., (1964) showed that over 55% of movers spent more on housing after the move than they did before.

(iii) *General Condition of Dwelling and Neighborhood:* The general condition of both dwelling and neighborhood (as indicated by such variables as state of upkeep, cleanliness, and existence of noxious facilities nearby) are important elements of the household's environment. As might be expected, those living in poor quality housing and in deteriorating neighborhoods are more likely to express movement desires than those who live under better conditions. However, more detailed analysis depends on providing suitable operational definitions for housing and neighborhood "quality." So far, the best procedure has been the use of independent interviewer and respondent ratings of dwelling and neighborhood (Butler et al., 1969). Table 3 shows that a consistent relation was established between low dwelling and environment ratings and movement response.

A factor of particular interest is the *effective range* of the impact of a given environmental attribute on movement response. In other words, given a facility such as a railroad, expressway, factory, or public utility, how close does this facility have to be to a dwelling in order to generate favorable or unfavorable reactions? Little detailed research has been undertaken on this topic, but one study in Toledo (Colony, 1969) provides some interesting insights. A sample of 138 residents was selected from an area adjacent to a depressed section of the Detroit-Toledo expressway. Of those living immediately adjacent to the expressway, 2 out of 3 respondents said that the noise from the traffic was so bad that they would never choose such a location again. However, the noise effect appeared to decline rapidly with distance such that Colony concluded that the economic effect of noise from the expressway was fully attenuated within a block of the facility. Yet we find in many prelocation studies that it is common for people living up to a mile away from the proposed facility to express considerable concern for the potential effects of noise. One implication that might be

TABLE 3: ASSOCIATION BETWEEN CONDITIONS OF DWELLING UNIT AND LOCAL ENVIRONMENT AND MOVEMENT RESPONSE

A. *Respondent Evaluation* Variables for which there is association between respondent *dissatisfaction* and movement propensity	*Highly Significant* ($p \leq .001$)	*Moderately Significant* ($.01 > p > .001$)	*Not Significant* ($p > .01$)
1. Housing Evaluation	X		
2. Neighborhood Evaluation	X		
3. Sufficiency of Rooms	X		
4. Sufficiency of Bedrooms	X		
5. Sufficiency of Bathrooms		X	
6. Accessibility Satisfaction	X		
B. *Interviewer Rating* Variables for which there is an association between a *poor* rating and movement propensity			
1. Interior appearance of dwelling unit	X		
2. Exterior appearance of dwelling unit	X		
3. State of repair of dwelling unit	X		
4. State of repair of dwelling units on respondent's street	X		
5. General rating of respondent's street	X		
6. Type of traffic carried on respondent's street			X
7. Noise level in respondent's neighborhood	X		

Source: Adapted from Butler et al. (1969) p. 53.

drawn from this study is that households find adjustment to particular environmental stressors easier to accomplish than might be imagined and that expressions of concern regarding potential stressful situations provide relatively poor guides to actual behavior.

(iv) *Accessibility Characteristics of the Present Location:* The question of effective ranges of environmental impacts brings us to the more general problem of the effect of accessibility to work and to amenity on locational valuations. Much has been written, especially by economists, regarding the importance of the journey to work in selection of the residence. In particular, it is argued that cost of the journey to work relative to other household expenditures generates a residential pattern of increasing socio-economic status with increasing distance from major workplace locations (Kain, 1962). One would expect, on the basis of this literature, to find that accessibility to work and also to amenities such as shopping centers, playgrounds, schools, and medical services strongly influences movement decisions. However, in almost every study which has made observations on individual desires to move, the impact of accessibility is apparently negligible.[3] In a recent national survey (Butler et al., 1969), the only case in which accessibility is reported to be a significant element in the decision to move is for individuals who live more than 40 minutes from work; this group possesses substantially higher propensities to move than the group living less than 40 minutes from work.

Redding (1970) has suggested that the relation between accessibility and residential location is somewhat more subtle than implied by earlier analyses. His study postulates that the relation between accessibility and locational valuation is nonlinear: *high proximity* to work and to amenities as well as *low accessibility* produce a stressful situation for households. In other words, living close to the downtown area, to shopping center, school, hospital, or playground as well as to work may be associated with a sufficient number of undesirable attributes (noise, traffic, industrial smells) that higher levels of dissatisfaction may also be found in these situations. Figure 3 illustrates the hypothesized relation between accessibility and stimulus to move for a given amenity; any attempt to identify a linear relation between dissatisfaction and accessibility will obviously be unsuccessful.

[3] This does not destroy the utility of the economic formulations, which are primarily oriented toward the theory of urban land values. Arguments relating to the accessibility of particular locations to potential markets or to the labor force still hold; it is the inferences regarding residential choice behavior which are incorrect.

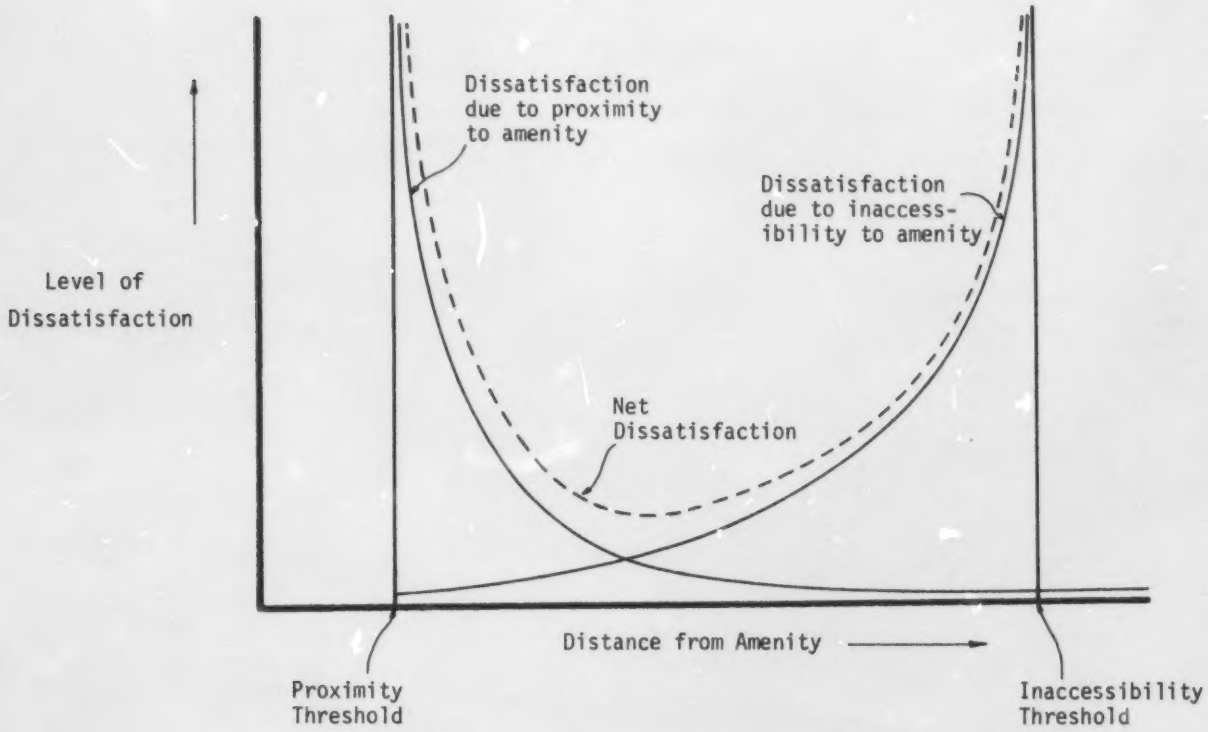


Figure 3. Relation Between Locational Dissatisfaction and Accessibility to Amenity
Source: after Redding (1970)

Application of these ideas for four amenities (shopping center, elementary school, playground, and hospital) to a sample of residents in Skokie, Illinois, indicated that nearness as well as inaccessibility thresholds exist for most individuals. In most cases the inner thresholds were one-quarter to one-half block from the given amenity.

(v) *Social Composition of the Neighborhood:* Complaints about the social composition of the neighborhood arise in two ways: either the neighborhood is undergoing some social change which the individual deems undesirable or the individual's expectations regarding his social environment change. Rossi's study indicates that both of these sources of motivation were almost equal in importance, but appeared to be generally less important in motivating a move than reactions to specific characteristics of the dwelling. Part of the problem in evaluating the contribution of neighborhood composition to movement response is that it is a sensitive issue for interview studies. It is an easy matter for respondents to rationalize decisions made on the basis of racial or ethnic prejudice by citing factors such as "better schools in the new neighborhood" or "the desire to live on a more secluded lot" as the basis of their decision. However, in neighborhoods whose racial composition is rapidly changing, the impact of in-migration of blacks is well illustrated by the effectiveness of models which postulate that the leaving rate of whites is proportional to the ratio of black and white in the area (Rose, 1969; Levine, 1968). This situation is also repeated in other contexts as in the case of the influx of Southern Europeans into British dominated neighborhoods in Australian cities (Moore, 1969). The influx of an ethnic group, many of whom did not speak English, is often associated with substantially higher levels of turnover among the British-born in the area.

(b) Positive attractions of alternate locations

In most cases, the "pull" of another dwelling opportunity is contingent on the recognition of a set of life-style aspirations on the part of the household. In developing an awareness of the variety of living environments offered by the city in which he lives (by

driving around or performing his daily activities), the individual may encounter vacancies which satisfy his aspirations. If they are attainable (i.e., within his capabilities to acquire them), the situation may stimulate a decision to move. The distinction between this aspect of the motivation to move and the deliberate search for a dwelling which satisfies specified criteria is a fine one: in the latter case the decision to seek a new residence has been made and the search is undertaken with the explicit purpose of achieving success within a specified time period, whereas in the former no such decision has been made, nor is there a commitment to be successful within any particular period.

Bell (1958) has recognized three types of life-style aspiration capable of motivating movement decisions:

(i) *consumption-oriented aspirations,* in which emphasis is placed on enjoying the material benefits of modern urban society. Locationally, these desires are most frequently expressed in terms of preference for in-town apartment dwelling close to a wide variety of urban amenities. Further, it is a life style most typical of the moderately affluent single person, or young couple without children; recently, some authors have also observed an increasing option for this life style expressed by older suburban couples whose children have left home and for whom the upkeep of a large house and lack of local amenity have become disenchanting.

(ii) *Social prestige-oriented aspirations,* in which the prime emphasis is placed on a life style perceived to be appropriate to one's job and position within the community. Typically this is expressed in terms of a desire for location in certain suburban areas of the city, which because of their more expensive housing and upper middle class social composition together with undoubted promotion on the part of the real estate operators acquire a prestige value among the mover's peers.

(iii) *family-oriented aspirations,* in which the provision of the 'right type of environment' for the children is stressed. Income is used to maximize the amount of dwelling and yard space and other family-oriented amenities; these motivations are most commonly reflected in the move of the young middle class family to the suburb.

To these three groups should be added a fourth:

(iv) *community-oriented aspirations,* in which the main stress is placed on the life style which can only be achieved through interaction with others with the same set of group-oriented values. The movement of a hippie to an inner city commune reflects this type of choice, as do some types of moves by retired people anxious for the companionship afforded by retirement communities.

Although Bell's discussion tends to present these varying aspirations with a trade-off context, it does not necessarily follow that they are incompatible. It is true that many prestige-oriented moves to the suburbs may also satisfy family-oriented aspirations. However, in reported reasons for moving, one type of aspiration usually dominates the others.

The discovery of attainable opportunities compatible with the household's life-style aspirations can therefore generate a strong stimulus to move. However, an important question arises as to the utility of these observations. It is evident that, "after the event," the statement of such aspirations provides a plausible explanation of the motivation for that move. On the other hand, Butler (Butler et al., 1969) shows that there are no significant differences between *intended* movers and non-movers with regard to the possession of particular life-style aspirations. This situation arises, at least in part, because the realization of such aspirations generally demands a marked change in dwelling characteristics either in terms of location or price or both. Satisfaction of life-style aspirations cannot usually be made within the local housing sub-market and hence the strength of inertial factors is usually greater than for other types of move. Thus we find that the majority of moves, which are primarily small adjustments within the local housing market, are motivated by negative reactions to the existing dwelling (push factors). However, it might be argued that the effect of many of these moves on the social and demographic characteristics of the neighborhood is minimal, whereas attempts to realize life-style aspirations (pull factors) may prove to be stronger generators of change in neighborhood characteristics by producing in-flows and out-flows for a given area comprising markedly different types of household.

2. Resistances to Movement

Although the net effect of deficiencies in the existing dwelling or attractions of attainable alternatives may be to produce dissatisfaction with respect to the present location, this is not, in itself, sufficient to stimulate a search for somewhere else to live. The cost of a move may be perceived to be too great when compared with the benefits from eliminating a small degree of dissatisfaction. Three factors appear to be most strongly related to these costs of movement.

(a) *Tenure:* The effort of moving, in economic and psychological as well as physical terms, is usually

much lower for renters than for owners. Many studies report a consistently higher propensity to move for renters than owners, irrespective of age or income (Boyce, 1969).

(b) *Duration of residence:* As the duration of residence in a particular dwelling increases, the probability of making a move in the next time period becomes less. This is probably due to the habits of the household becoming more strongly established and an increasing reluctance to initiate a fresh pattern of daily life elsewhere. This effect, formalized as the Axiom of Cumulative Inertia by McGinnis (1968), is correlated with age of the household head but, as Table 4 shows, the duration of residence effect can still be detected when age is controlled.

(c) *Strength of social networks:* For a long time it was thought that accessibility to friends and relatives was a vital factor in the stability of the household. Recent interview studies have tended to question this assumption. Apart from the elderly, whose ability to get around the city is often limited, few respondents in the National Survey considered accessibility to friends and relatives to be important.[4] However, discussions such as that by Jane Jacobs (1961) of Boston's North End suggest that more attention should be given to the qualitative aspects of social interaction rather than to the mere existence of certain numbers of spatial linkages. Particularly if social interaction serves to integrate the individual in the functioning of the local community, the inertial effect on plans for change of residence may be considerable.

[4] The National Survey refers to the study by Butler et al., (1969).

TABLE 4: PROPORTION OF POPULATION MOVING WITHIN ONE YEAR BY AGE AND DURATION OF RESIDENCE FOR A SAMPLE OF RESIDENTS OF AMSTERDAM.

Duration of Residence (Years) \ *Population Age Group*	*18–24*	*25–44*	*45–64*
0– 1	.272*	.116	.120
1– 2	.328	.108	.094
2– 3	.236	.108	.076
3– 4	.244	.096	.044
4– 6	.174	.090	.038
6– 8	.106	.080	.036
8–10	.122	.068	.044
10–15	.064	.030	.010
15–20	.066	.030	.008
20–25	.080	.022	.006

*Each of these values is subject to sampling error. The standard error of the estimated proportions varies between 10% and 20% of the tabulated values.

Source: Morrison (1967).

3. The Role of Specific Associations

Much of the literature concerned with residential mobility has focussed attention on the reporting of specific correlations between attributes of the population and the propensity to move. Some, such as the high correlation between renting households and the propensity to move follow directly from the above discussion. Others, however, need to be more carefully interpreted in the light of the general structure we have presented. In particular, we must be very careful not to impute unjustified causal linkages between two variables merely on the basis of a high observed correlation. Three associations are of particular interest, as they occur with great frequency in reported studies.

(a) *Stage in the Life-Cycle:* Perhaps the most frequently reported correlate of movement propensity is stage in the life cycle. As families form, grow, stabilize, and then disperse, so the probability of movement changes. It is in the early stages of the family history that moves are most likely to occur, first upon marriage, then as children arrive and housing needs change markedly. The years during which the children are at school and the head of the household is consolidating his career are those of high stability; finally, there is some tendency to adjust to too much space when the children leave the family home.

The general characteristics of the life cycle relation appear in Figure 4 which shows the relation between movement propensity and age for both males and females. The highest probability of moving is experienced between the ages of 20 and 30. From this age onward, movement propensity declines steadily. Some authors have argued for a secondary peak between 45 and 55 when the children are likely to be leaving the parental home, but since this move is often postponed for the few extra years until retirement, the peak is not noticeable, at least in these data.

The specific effect of size of family is difficult to detect. It appears to be more of a determinant of the desire to move than of the actual act of moving, for it is the large family which often finds the greatest constraints against moving imposed upon it, both from financial considerations and in terms of the number of possible alternative dwellings available. In Rossi's Philadelphia study over 80% of four-person, renting households wished to move from their present residence, yet it is this same group which

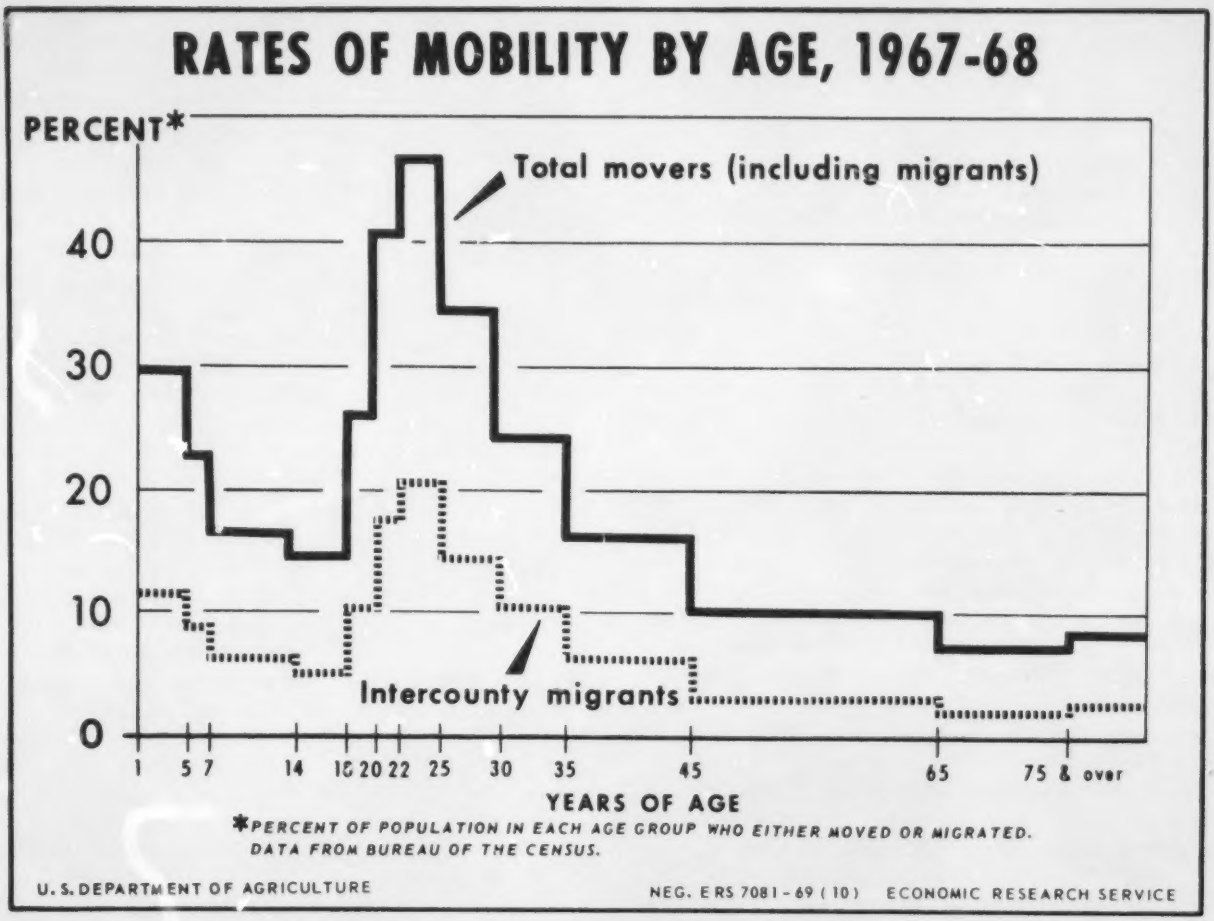


Figure 4. Variation in Population Mobility by Age for The United States 1967-68
Source: U.S. Department of Agriculture (1969)

experienced by far the highest incidence of "unexpected stayers," i.e., those who were unable to fulfill their desire to move, primarily through their failure to discover suitable alternatives.

The correlation between stage in the life cycle and mobility is to be understood primarily in terms of the effect of changing needs with respect to dwelling space and neighborhood characteristics as the structure of the family changes. The implication is that the majority of communities will experience a certain amount of mobility from this process and if a community is designed to appeal to a particular age group it will experience a level of mobility appropriate to that age group. This observation is particularly pertinent to the planning of apartment complexes oriented toward young married couples in inner city areas, for the developer must anticipate a fairly high natural turnover of occupants (perhaps over 40% per year).

(b) *Socio-Economic Status:* Research relating to the relation between socio-economic status and mobility has yielded conflicting results. Some studies report higher propensities to migrate among higher status groups, particularly professionals (see U.S. Dept. of Agriculture, 1969), whereas other studies such as Butler, et al., (1969) are unable to detect any relation between the two variables. A third set of studies including Simmons (1968) and Moore (1966) argue that higher status groups exhibit a greater propensity to undertake long-distance, particularly intercity job-related, moves; however, lower status groups exhibit a greater amount of intra-urban mobility thereby producing an overall lack of correlation between socio-economic status and the propensity to move.[5] In fact, socio-economic

[5] This dichotomy emerges clearly in the detailed statistics found in the U.S. Dept. of Agriculture, (1969).

status is confounded with most of the other variables of interest (age of the household head, the type and condition of the dwelling occupied, tenure status and, indirectly, accessibility to work) such that the overall correlation possesses little meaning even when broken down to within and between city movements. Further implications of this situation are discussed in Part II, A, 2.

(c) *Race:* Although the associations between movement response and stage in the life cycle or dwelling conditions can be interpreted in terms of direct functional relations, the situation is very different for the frequently observed high correlation between race of respondent and movement propensity. Non-whites in the United States have been shown in a number of different studies, to possess markedly higher incidence of expressed desire to move, although the extent to which this is reflected in subsequent behavior is not so strongly documented. However, it does not seem reasonable to argue that non-whites possess inherently greater propensities to move than whites. A more plausible explanation of the observed racial differences is that non-whites have a greater likelihood than whites of living in poor-quality rented housing, of having larger, younger families, and of having been recent arrivals in the urban area. Each condition is associated with higher propensities to move. The main problem in pursuing a more critical analysis of these ideas is the selection of suitable matched samples of whites and non-whites possessing similar demographic and housing attributes; yet it is only by taking the effort to construct such samples that we can meaningfully explore the differences in mobility experience between different racial or ethnic sub-groups.

While we may make extensive use of correlations between certain population characteristics and mobility experience to derive expected movement rates for specified population sub-groups, we must be extremely careful in constructing causal statements from such associations. The three examples given above illustrate some of the complexities in trying to interpret observed correlations.[6]

4. Concluding Remarks

The previous pages have presented an interpretation of results of interview studies which have been expressed largely in terms of either correlations or cross-tabulations between population characteristics and the propensity to move. It is evident that the role played by change of residence in the life of the individual household varies considerably from one household to another. The outcome of our discussion is an understanding of some of the factors affecting the decision to seek a new residence, but there are many questions left unanswered by existing research.

First, most of the analysis undertaken in existing studies is of a bivariate nature leading to statements such as "renters have a higher propensity to move than owners" or "the probability of change of residence for a given household is a function of the stage in the family life cycle." In our everyday experience we recognize that particular aspects of a situation tend to reinforce each other: we would expect that the young couple who rents a small apartment in the inner city and who has just had a child is more likely to move in the near future than the established family who has rented the same house in the suburbs for the last ten years. In examining these more complex situations, one possible strategy is to (1) identify those combinations of attributes which are associated with very high propensities to move, (2) identify the converse—those situations in which mobility is very low, and (3) attempt to come to grips with the very difficult question of what is the expected rate of movement for a given type of household in a given environment such that situations which deviate greatly from the expected rates can be identified. Progress toward satisfying these three goals is likely to be slow, for the data requirements are enormous if we wish to pursue any degree of cross-classification of households and environments. For example, if we classify households simultaneously by income (using say 4 categories), tenure status (2 categories), stage in life cycle (4 categories), type of dwelling (3 categories), and distance from work (2 categories) we have 192 classes. To obtain good estimates of movement propensities for each class we would need something of the order of 10,000 observations (50 per cell). As an example of a study which is large by present standards, the National Survey (Butler et al., 1969) obtained only 1500 interviews spread over 43 metropolitan areas of the United States.

Second, if we are concerned with explaining why some households move in a specified time period and others do not, it is imporant to consider why households *do not move* when a move might be strongly anticipated on the basis of prior knowledge of the factors affecting the propensity to move. For example, given the types of factors affecting the decision to move (conditions of dwelling and neighborhood, tenure, and ethnic composition) we might expect even higher rates of movement in deteriorating inner city districts than are observed. However, in many cases, the household does not perceive that any better opportunities are attainable within the constraints of its budget and a

[6] It is interesting to note that the three associations discussed here refer directly to the three main dimensions of urban structure identified by social area analyses: family status, socio-economic status, and ethnic status (Rees, 1970). In reading this literature, it is important to remember the problems which arise in inferring particular processes on the basis of observed correlations, since much of the analysis is based on interpreting correlation coefficients.

move is not contemplated. Of particular interest to the planner is the extent to which improved dissemination of information regarding opportunities could result in greater ability of such households to adjust to their housing needs and desires within the existing market framework.

Finally, from the point of view of comprehensive coverage of the generation of moves it is evident that the genesis of forced moves is poorly treated in the literature as a whole. Their existence is recognized, and it is estimated that they form about 40% of all moves within the city The number of displacees produced by a specific renewal project can be taken as completely specified by the design of the project, but other organizational and institutional effects are more difficult to evaluate. Moves of large companies from the central city to the suburb inevitably generate some moves (as well as some labor turnover), but the overall significance of this process is not well understood. For example, are relocations more likely to occur for higher or lower skill classes? To what extent are both the changes of residence and the labor turnover dependent on the relative locations of the worker's existing residence and the new employment site?

More subtle are the promotional influences of real estate developers. Their strategy is to attempt to create images for specific subdivisions which are sufficiently in accord with the life-style aspirations of a particular sub-group to stimulate moves by members of that group. Again, we know little of the effectiveness of such actions, yet we can hardly ignore them in trying to identify the main forces underlying the composition of specific flows from city to suburb.

It is answers to the types of question posed above which must be provided to establish a basis both for a theory of intra-urban migration and for improved planning decisions. The interview studies undertaken to date are a starting point, but they do not provide direct answers to our questions: their main contribution is to indicate those factors related to movement behavior which might form a basis for more detailed analysis.

B. Search for and Selection of a New Residence

In some cases, as we noted in Section A, the decision to move was motivated by discovery of a specific attainable alternative. More usually, it is only the decision to seek a new residence that has been taken (or imposed) and the household must then begin to search for a suitable dwelling vacancy. It is convenient to consider this process in three stages (see Figure 5).

(1) the establishment of criteria for evaluation
(2) the search for attainable alternatives
(3) the evaluation of alternatives and the final selection

The first and last parts will be considered but briefly, for it is the search procedure which has received the greatest attention in the geographic literature. The individual utilizes his perception of the urban area (with many distortions and biases contained in that perception) to organize the search. Although the majority of search activities may entail examining newspaper or real estate listings rather than travelling through the city, the outcome in terms of the vacancies encountered depends very largely on the way in which these activities are structured and hence on the a priori perception that the individual possesses of his urban environment.

1. The Establishment of Criteria for Evaluation of Dwelling Vacancies

In large measure, the criteria specified by the household reflect the motivations of the decision to seek a new

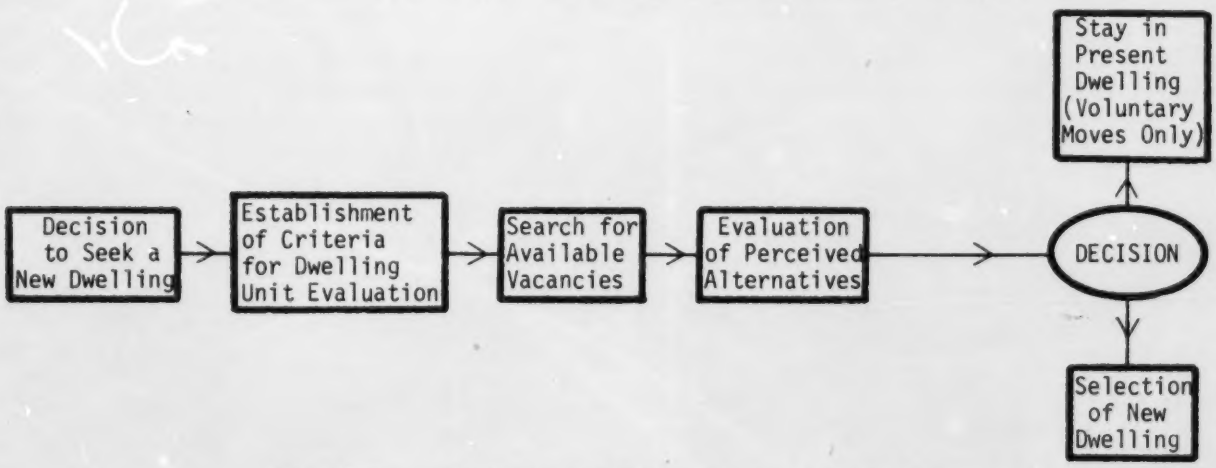

Stay in Present Dwelling (Voluntary Moves Only)
Decision to Seek a New Dwelling
Establishment of Criteria for Dwelling Unit Evaluation
Search for Available Vacancies
Evaluation of Perceived Alternatives
DECISION
Selection of New Dwelling

Figure 5. Elements Considered in the Individual's Selection of a New Residence

dwelling. In Rossi's study, the most frequently stressed requirement was the existence of adequate living space which reflects the dominant source of complaints about the previous dwelling. Similarly we can expect dwelling condition, neighborhood condition, availability of amenities, and attributes reflecting various life style aspirations together with an appropriate cost constraint to enter into the list of frequently specified criteria for evaluation. Table 5 presents the responses from Rossi's study to the question of what were the important things the household had in mind when looking for a place to live. The number of specific criteria that might be reported by a group of respondents is obviously very large; however, a number of comments are relevant. First of all, the number of aspects of dwelling and environment that will be considered by a given family is quite small, for it is extremely difficult for the household to cope with the problem of comparative evaluation if the list of criteria is large. Many of the variables used in individual valuations are correlated and this suggests that if the large number of variables can be reduced to a smaller number of dimensions, the subsequent analysis may be simplified. Some tentative steps have been made in this direction: see Peterson (1967). However, problems might still be encountered; Miller's (1956) study of individual perception indicated that only rarely can objects be discriminated effectively on the basis of more than seven dimensions; even at this level considerable cognitive stress is experienced.

TABLE 5: PROPORTION OF MOVERS LISTING DIFFERENT CRITERIA FOR SELECTION OF NEW DWELLING

*SPECIFICATIONS**

	%
I. Specific Dwelling Unit Attributes:	
Particular space dimensions	51
Particular design requirements (heating, layout, utilities)	50
Costs (rent, maintenance, or purchase price)	19
Other dwelling unit attributes	16
II. Specific Neighborhood Attributes:	
Social Composition	6
Location	26
Other Neighborhood Attributes	9
III. Other Considerations	5
IV. Vague Considerations	13
V. None ("looking for anything")	5
100% equals	(444)

*The specific wording of the question which elicited the reasons in this table was as follows: "What were the important things you had in mind about a place when you were looking around?"

"Other dwelling unit attributes" included such qualities as cleanliness (mainly referring to furnished units), details of construction (frame, brick, detached, attached), and so on.

"Other considerations" consisted primarily of "availability," e.g. "I needed a place right away and I would have taken anything that was available."

"Vague considerations" included such responses as "a better apartment," "nicer neighborhood," etc. In part, the large number of vague responses indicates poor interviewing since such responses should ideally be followed with probes to bring out specific details. But, in large part, the high proportion of such responses indicates the difficulty respondents felt in verbalizing such matters.

Source: Rossi (1955), p. 154.

It is evident that not all criteria can be equally important for a particular household, the implication being that it is willing to trade-off desirable properties on a less important criterion for desirable properties of a more important element. Butler et al. (1969), for example, provides the following statement regarding the preferences of movers within the city: "Metropolitan households prefer

(1) better neighborhood quality, with either a less desirable housing unit or less accessible location over a less desirable neighborhood with either a better housing unit or better accessibility (overwhelmingly–approximately 70 percent to 27 percent)
(2) a place that has a very nice appearance inside and less desirable outside appearance to a place that presents a very nice outside appearance but less desirable appearance inside (overwhelmingly–80.4 percent to 14.2 percent)
(3) better than average schools with higher taxes to lower taxes and less desirable schools (overwhelmingly–78.3 percent to 15.2 percent)
(4) a conflicting combination of a new or fairly new house together with a well-established neighborhood
(5) modern architectural styles to traditional (barely–45.5 percent to 37.6 percent)
(6) a housing unit all on one floor
(7) few children in the neighborhood
(8) large lots to small lots."

These are statements generalizing the responses of a sample spanning a wide variety of household types. If specific population sub-groups are considered, the importance of particular criteria change. For example, Ross (1962) notes that for movers from suburbs to central city both accessibility to amenity and quality of schools play an important role in the locational choice, whereas for flows in the opposite direction, the characteristics of the dwelling itself and available space for the family are the dominant criteria. Further, for many movers to new subdivision developments in the suburbs, the presence of other children in the neighborhood is a strong attraction.

These comments indicate that we must be careful to

distinguish between a statement of consensus regarding preferences for dwelling and neighborhood attributes for the total population and statements permitting evaluation of the potential success of a particular development. Although many suburban subdivisions are a conservative response to the type of preferences expressed in the consensus statements, many examples are to be found of developments which cater to preferences of a minority of the population yet are undoubtedly successful (such as the Sandburg Village which is a high density, upper income apartment development close to downtown Chicago). There is a world of difference between the type of market analysis required for evaluation of a proposed project and generalizations concerning the preferences of the whole population.

We can divide the evaluative criteria into two groups: those associated with the dwelling itself, the *site* characteristics, and those associated with the immediate surroundings, the neighborhood, and accessibility to a wide variety of activity nodes in the urban area (place of work, shopping center, hospital, schools, recreational facilities, friends and relatives), the latter constituting the *situational* characteristics. In order to cope with the problem of acquiring and organizing information regarding possible opportunities, it is suggested that the household goes through the following steps (Brown and Moore 1970b).

(a) It defines a *range* or *subset* of values for each criterion variable (depending on whether the variable is measured continuously or discretely) as acceptable. If a given vacancy possesses a characteristic whose value falls outside the acceptable range, the vacancy is automatically excluded from further consideration. For example, a family might be searching for a duplex or an apartment for rent between $150 and $200 per month. Only vacancies satisfying these conditions might be considered worthwhile visiting.

(b) Search is organized primarily in locational terms, attention being focussed on selected areas within the city. Areas are selected on the basis of a) their perceived situational characteristics and b) the household's subjective evaluation of the probability of finding vacancies satisfying their site criteria. These areas are then searched for vacancies satisfying the specific site characteristics desired.

2. The Search for Attainable Alternatives

The role of information acquisition and utilization is critical in the selection of a new residence. There are four main *sources* carrying information about dwelling vacancies:

(a) Mass media, particularly newspapers
(b) Specialized agencies, primarily estate agents
(c) Display boards
(d) The household's network of social contacts

Two measures can be used to identify the importance of each of these sources: the proportion of movers who use a given source, and the proportion of times in which the use of a given source leads to the vacancy which is finally selected (the latter measure is termed the *effectiveness* of the source). From such an analysis Rossi established that personal contacts, while being the second most frequently used medium (after newspapers), were by far the most effective. This finding regarding the importance of personal contacts is consistent with similar observations in the diffusion literature concerning the effectiveness of different information sources (Brown, 1968; Gould, 1969; Hägerstrand, 1966).

If we assume that the majority of effective information regarding vacancies as well as the household's prior knowledge of the urban area depends on the pattern of personal contacts, we have the problem of specifying the extent and intensity of the household's activities in the urban area. At the individual level, this is a difficult task as the number of locations visited by a household in the course of a week (a reasonable observation period) is often quite small and the resulting patterns confusing. We need some further conceptual notions to provide structure to the analysis.

In the simplest case we can argue that observed patterns of interaction are a function of two factors: (1) the household's willingness to travel different distances for a given purpose, and (2) the distribution of possible destinations for a trip of that purpose. In general (although not always), we can assume that the individual would prefer to travel shorter rather than longer distances to attain a given objective.

In a rural area one might make the assumption that the distribution of opportunities is fairly uniform and that the number of opportunities per unit area is roughly the same at each location. The expected form of the resulting pattern of contacts for a given individual would then strongly reflect the household's distance bias in preferences for trips of different lengths. The contact field would be circular, symmetric, and possess declining numbers of contacts per unit area with increasing distance from the individual (see Gould's discussion of the Mean Information Field [Gould, 1969]). In an urban area, however, the distribution of opportunities for interaction tends to be highly concentrated toward the center of the city and the pattern of

interaction for a given individual is not indifferent to his location in the urban area. The association of a simple distance bias in trip preferences with the type of distribution of opportunities found in most cities with a single dominant nucleus generates the set of interaction patterns shown in Figure 6 for different household locations.[7]

A sectoral bias exists in these hypothetical interaction patterns even without assumptions regarding the nature of the transportation network. Evidence of the sectoral bias is provided by the disproportionate number of contacts found in the sector in which the individual is located: this is demonstrated for a 60° sector in Figure 6. Real-world situations are more complex. First, as in shown in Figure 7, the simple form of the contact field in Figure 6 appears as the minor component in the overall pattern, with the major component being a neighborhood effect centered on the individual (see Brown and Moore, 1970b, for further discussion). This additional component further accentuates the sectoral concentration of the individual's contacts. If we then assume a radial transportation network of the type found in most major American cities, the effect will be to accentuate the sectoral bias still more by increasing the inter-point accessibility within each sector and reducing it between sectors. Strong sectoral biases have been noted both in migration fields (Adams, 1969) and in the household's perception of the social status of neighborhoods within the city (Johnston, 1971). The bias in perception, of course, contributes to the bias in the migration patterns, as households have a tendency to regard neighborhoods in other parts of the city as being less desirable than neighborhoods in their own sector.

The patterns discussed above apply to the general population. Specific population sub-groups may possess more strongly constrained information fields. In a study of group images in Los Angeles, for example, Orleans (1968) found that non-white (particularly Mexican) and low-income groups had much more spatially limited mental images of the city than affluent white groups. This reflects both the lower mobility (in terms of day-to-day intra-city movement) of these groups as well as the highly concentrated distribution of opportunities for personal interaction.

The actual search for a new residence is a function of the household's information field and the distribution of vacancies. The meager evidence available regarding individual search patterns lends support to the two main ideas outlined above, namely that:

(a) *in aggregate,* search patterns reflect both the distance and sectoral biases evident in personal contact fields. The properties of search patterns and contact fields tend to vary in similar ways over different population sub-groups (Brown and Holmes, 1970). For example, for low-income, inner city dwellers both aggregate patterns of social contacts and patterns of vacancies visited in the search for a new residence are much more compact and localized around the former residence than for higher-income suburban dwellers; for the latter group, vacancies visited are both more widely spread and exhibit much greater tendencies to concentrate in the sector in which the move originated.

(b) *for the individual,* vacancies visited tend to be concentrated in small areas around the site of the dwelling finally chosen. This finding lends support to the notion that search is sequential in that the neighborhood in which the mover would like to live is selected first and then this area is searched intensively for vacancies possessing the desired site characteristics. It is the first stage of this process which is dependent on the household's information regarding the characteristics of the urban area in which he lives.[8]

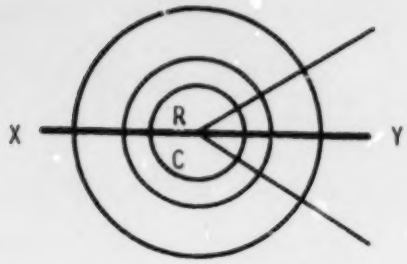
3. Evaluation of Alternatives

For many movers, the establishment of criterion variables and associated ranges of acceptable values allows the household to eliminate most vacancies from serious consideration. For many households, only the residence chosen is seriously considered or even visited. In part, this reflects a screening of possible vacancies in the examination of newspaper and real estate listings: however, it also reflects the uncertainty of the search situation from the point of view of the household. It is looking for vacancies which satisfy specified criteria for acceptability, although it is usually recognized that some acceptable vacancies are more desirable than others. However, when an acceptable vacancy is discovered, the household is faced with a dilemma of taking that opportunity or looking for a more desirable vacancy knowing that a) more desirable vacancies probably exist in the urban area; b) he may not find one in a reasonable amount of time; and c) the acceptable vacancy he has discovered might be taken by someone else while he is looking for something better. The relatively small number

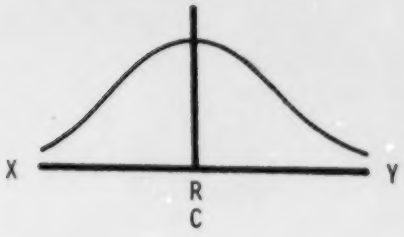
[7] More detailed discussion of these patterns are to be found in Moore (1970) and Brown and Moore (1970b).

[8] This procedure is analogous to the "space covering" and "space organizing" stages of search for economic potential considered by Gould (1966). Promising areas are searched for signs of economic rewards; when evidence of particular resources are discovered in a part of the general search area, the second stage of a more intensive search of this subregion begins.

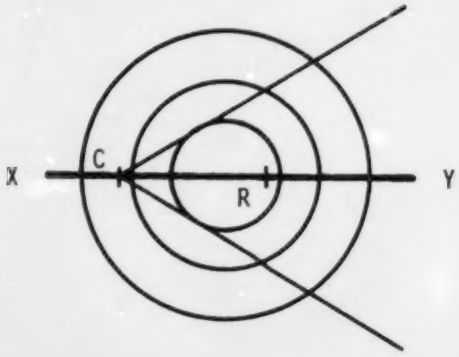
A. Respondent Located at City Center
(60^{o} sector contains 1/6 of contacts)

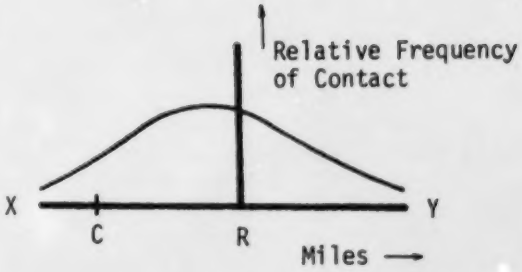


Cross-Sections through
Contact Field along X-Y

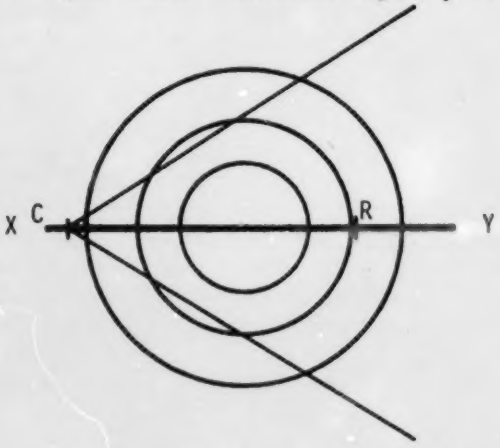


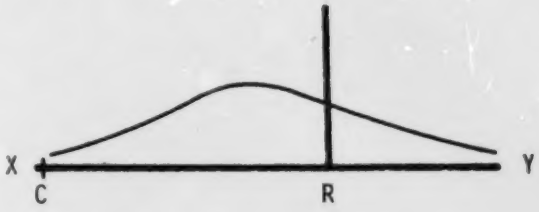
B. Respondent at Mid-point Location
(60^{o} sector contains more than 1/6 contacts)





C. Respondent Located near Periphery
(60^{o} sector contains majority of contacts)





R = LOCATION OF RESPONDENT
C = LOCATION OF CITY CENTER

Figure 6. Variation in Urban Contact Fields with Distance from City Center

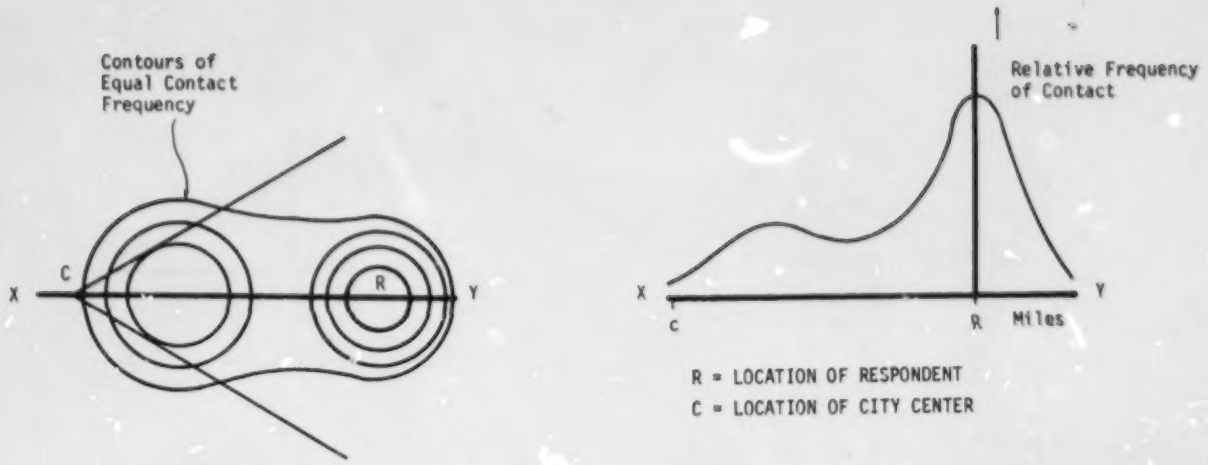


Figure 7. The Structure of Urban Contact Fields Showing a Neighborhood Effect

of dwellings considered by most movers[9] probably reflects a conservative strategy adopted by the majority of taking a vacancy which is acceptable rather than continuing to look for the "best possible outcome."

Time plays an extremely important role in the outcome of the search procedure, particularly when a constraint is imposed on the period in which a new residence must be found. This situation is of greatest relevance to those who are evicted, displaced by renewal, or otherwise have the decision to move imposed upon them. For the majority of these movers, the sheer necessity of providing a roof over their heads imposes a substantial time constraint. The result is that not only must fairly wide ranges be used to identify acceptability for each criterion, but also the household is under strong pressure to take the first vacant dwelling satisfying the very broad definition of acceptability. Under these conditions it is highly probable that the household will make a poor choice and will be motivated to move again within a fairly short period of time. The problem is made all the more severe in cases of large-scale urban renewal projects in which considerable numbers of households are thrust into the market at the same time, a market which is seldom able to accommodate them. The result is that many are forced to take highly undesirable opportunities merely to guarantee shelter, often in the form of moving in with friends and relatives in nearby areas thereby further increasing the pressure on space in the latter households.

Given the individual's criteria of acceptability, coupled with his tendency toward conservatism in uncertain situations, we find that many movers take the first acceptable opportunity which presents itself. In cases where more than one alternative possessing desired characteristics is encountered, the most frequently used choice rule is to select the lower cost alternative (Rossi, 1955). In general, this choice of the lower cost alternative results in some trade-off with respect to other factors, particularly accessibility and available living space in the dwelling, although both of these criteria still have to lie within the range of acceptability.

4. Concluding Remarks

We have argued that the process of searching for and selecting a new residence depends on two critical elements: (1) the individual's information regarding the characteristics of the urban area in which he lives, and (2) the location of vacancies satisfying the household's criteria of acceptability at the time he is looking for another dwelling.

With respect to the former, generalizations regarding individual perception of the urban environment have been somewhat limited, but the topic is the focus of much current research. (Saarinen, 1969, has some discussion of this topic.) In particular, attempts are being made to establish the nature of relationships between individual perception and the pattern of trip-making behavior. This endeavor is based on the premise that the main elements of the individual's perception of his surroundings derive from direct contact and that indirect sources such as mass media act in a relatively minor way.

With regard to the location of vacancies, we know little which is directly relevant to the individual movement decision. First, we do not have accurate data on the vacancy rates for particular types of structures and, second,

[9] Butler, et al. (1969, p. 41) indicate that only about 60% of movers seriously consider the residence to which they move.

we have only general notions as to the degree of selectivity exercised by owners and managers of property in finding new owners and tenants, although much useful information must be embedded in the practical experience of professional realtors. We do know that the actual number of vacancies seriously considered by the household is generally very small, yet we do not know the extent to which this reflects prior screening of vacancies, the conservatism of the household in taking the first acceptable opportunity encountered, or the scarcity of appropriate vacancies. Probably, all three factors are important, but if we wish to clarify the issue, some attempt should be made to identify the number of viable opportunities for samples of households searching within the urban area.

A basic planning question which arises out of the above comments concerns the development of comprehensive, continually updated data files concerning the attributes of vacancies in the urban area. We know that many households make poor choices of new dwellings; much of this is due to having to make a decision based on very limited information and highly inefficient and personalized search procedures within a short period of time. The question is whether the cost of developing such a data system would be justified in terms of the number of households who would make improved choices of their new residence. Although this question poses further problems in terms of the evaluation of the efficacy of the new system (is it to be evaluated in terms of reduced rates of movement subsequent to use of the data system?), it would seem to be a logical development of the discussion pursued above.

PART II. RESIDENTIAL MOBILITY AND THE CHARACTERISTICS OF URBAN NEIGHBORHOODS

We now turn our attention to the impact of large numbers of individual changes of residence on the city as a whole. The ebb and flow of in-migrants to the city, of out-migrants to other parts of the country and the transfer of households between sub-areas within the city is the basic mechanism underlying changes in the spatial distribution of the characteristics of the urban population. However, the number of individual events is so large that it would be impossible to consider the characteristics of each move individually. During a given 12-month period, approximately 250,000 persons will be involved in changes of residence in a city of one million. We need some framework for origanizing our discussion of residential mobility at this scale.

The classical models of urban growth, the concentric zone model of Burgess and the sectoral growth model of Hoyt (see Mayer, 1969) both contain general statements regarding residential mobility. The former argued that continued in-migration focussed on poor central districts accompanied by an expanding central business district generated a net outward movement of population within the city. Pressure of increasing population and reduced residential land at the center caused members of the innermost group to *invade* adjacent residential areas. Residents of the latter areas in turn invaded the areas next to them in terms of distance from city center. The overall result was a wave of outward movement producing a temporal *succession* of occupancy by progressively poorer groups at any given distance from the center of the city. Hoyt's model modified this picture to argue for the dominance of development along transportation routes radiating from the downtown area. In particular, the progressive outward movement of high rent districts tended to draw the growth of the rest of the city in their wake.

These simple models are not very appropriate for examining mobility in most present-day large North American cities. In-migrants to the city locate initially in many parts of the city, not just in the center (see Section II, C). Some areas maintain their characteristics for long periods while others change rapidly and the contribution of mobility to stability and change in population characteristics is not easy to identify (see II, A, 2, Types I through IV). Finally, the patterns of flow and counter-flow are much more complex than the simple statements regarding radial movement would suggest. In fact, the ensuing discussion is concerned primarily with *how to represent* the detailed movement pattern in such a way that its essential properties can be identified and can be related to discussion in Part I. Having established this base-point, we can make some general statements regarding the association between mobility and neighborhood change.

In developing a representation of the movement pattern, our first assumption is that for any city that we might wish to study there is an operational definition of the boundary of that city (see Mayer, 1969, p. 3 ff., for a discussion of different definitions). The city so defined constitutes an *open population system* insofar as transfers of households take place across its boundaries. Each change of residence appropriate to our study has either an origin or destination or both within the defined limits of the city.

Our second assumption is that the city can be subdivided into a number of small sub-areas which are mutually exclusive and exhaust the whole of the territory contained within the limits of the city. Let us say that there are n of these sub-areas. The question of how these sub-areas shall be selected is critical if we are to interpret the results of any subsequent analysis, but for the moment we shall assume that the task has been undertaken and we will return to methods of defining sub-areas later. Finally, in order to be able to treat the open system, we artificially close it by defining an $(n + 1)$-th area which consists of the entire territory which lies outside the limits of the city.[1]

We now develop a simple accounting model representing the aggregate flows we wish to analyze. First, consider the individual moves. Each move possesses an origin and a destination, each of which can be assigned to one and only

[1] Note that the cell in the $(n + 1)$-th row and $(n + 1)$-th column is left blank. The value $m_{n+1,n+1}$ would represent all the moves in the rest of the world which did not have either an origin or destination in the city being studied. Except under special conditions which do not concern us here, this value is of no interest.

one of the $(n + 1)$ areas we have defined. Thus from basic data referring to the origins and destinations of moves we can construct a table (Figure 8) representing the flows within and between all sub-areas. If we assume that there is no net effect due to births and deaths to movers in our study period, a number of simple characteristics can be derived from this accounting framework. For example:

(A) $\sum_{j=1}^{n+1} m_{ij}$ = total number of movers possessing an origin in area $i = m_{i.}$ (footnote #2.)

(B) $\sum_{j=1}^{n+1} m_{ij} - m_{ii}$ = total number of movers leaving area $i = m_i^*$

(C) $\sum_{j=1}^{n+1} m_{ji} - \sum_{j=1}^{n+1} m_{ij}$ = total change in population of area i due to residential mobility $= n_i (= m_{.i} - m_{i.})$

(D) $\sum_{i=1}^{n} m_{i,n+1}$ = total out-migrants from the city.

The interested reader can undoubtedly define further characteristics. Note that there is no reason why the table should apply to the total population. It could equally well refer to a specified age group, ethnic or racial minority, or any other partition of the population deemed relevant to a particular problem.

Although the table contains a great deal of descriptive data it is difficult to obtain much insight into the

[2] We define $\sum_{j=1}^{n+1} m_{ij} = m_{i1} + m_{i2} + \ldots + m_{in} + m_{i,n+1}$, which is the sum of the values in the i-th row $= m_{i.}$, which is the total number of movers possessing an origin in area i.

Similarly, $\sum_{i=1}^{n+1} m_{ij} = m_{1j} + m_{2j} + \ldots + m_{nj} + m_{n+1,j}$, which is the sum of the values in the j-th column $= m_{.j}$, which is the total number of movers possessing a destination in area j.

DESTINATION AREAS

ORIGIN AREAS	Within the City					Outside City
	1	2	i	j	n	n+1
1	m_{11}	m_{12}	m_{1i}	m_{1j}	m_{1n}	$m_{1,n+1}$
2	m_{21}	m_{22}				
3						
i	m_{i1}	m_{i2}	m_{ii}	m_{ij}	m_{in}	$m_{i,n+1}$
n	m_{n1}	m_{n2}	m_{ni}	m_{nj}	m_{nn}	$m_{n,n+1}$
n+1	$m_{n+1,1}$			$m_{n+1,j}$	$m_{n+1,n}$	

Figure 8. A Framework for Recording Changes of Residence in the City

characteristics of movement flows without further data on the distribution of the population. The evidence presented in Part I indicates that the presence of a particular set of attributes at a given location affects the *probability* of a resident electing to move in a given time period; it does not make the outcome certain. Therefore, we are concerned with the variation in the proportion of the population which moves in a given time period and, since the population size will generally vary from one sub-area to another, we cannot derive these rates directly from the movement data. We therefore assume that we can obtain data on the average population of each sub-area for the period in which we record changes of residence.[3] Let this value be P_i for the i-th sub-area. We define the propensity to move in area i as

$$r_i = m_{i.}/P_i$$

We now define a set of values q_{ij} which represent the *proportion of movers* who originate in area i who terminate their move in area j (note that $0 \leq q_{ij} \leq 1$ and $\sum_{j=1}^{n+1} q_{ij} = 1$). We stipulate that the set of in-migrants to area i from outside the city (the values $m_{n+1,i}$) are recorded separately. We now have the following situation for the entries in Figure 8.

$m_{ij} = P_i\ r_i\ q_{ij};\ i = 1, \ldots, n; j = 1, \ldots, n+1$ (footnote #4)

$m_{n+1,j}$ are determined separately; $j = 1, \ldots, n$

We can represent the first n rows of Figure 8 by the matrix form given in Figure 9. In this paper we treat the $(n+1)$-th row, the values $m_{n+1,j}$, as being exogenous inputs to the model. Further discussion of these values is found in Part

[3] Care must be taken in computing the average. If the time period is short and the growth rate of moderate proportions, then the arithmetic average of the population at the beginning and end of the period can be used. However, for larger time periods and rapid growth, the geometric mean of the endpoint populations should be used.

[4] For example, if the population of area i is 2,000, the proportion of the population leaving dwelling units in area i in a year is 40% and the proportion of those leaving dwellings in i who go to j is 10% (i.e., $P_i = 2{,}000$; $r_i = 0.4$, $q_{ij} = 0.1$). Then $m_{ij} = 2{,}000 \times 0.4 \times 0.1 = 80$.

$$\begin{bmatrix} m_{11} & \cdots & m_{1,n+1} \\ m_{21} & m_{22} & \cdots \\ \vdots & & \\ m_{n1} & \cdots & m_{n,n+1} \end{bmatrix} = \begin{bmatrix} P_1 & & 0 \\ & P_2 & \\ & & \ddots \\ 0 & & P_n \end{bmatrix} \cdot \begin{bmatrix} r_1 & & 0 \\ & r_2 & \\ & & \ddots \\ 0 & & r_n \end{bmatrix} \cdot \begin{bmatrix} q_{11} & \cdots & q_{1,n+1} \\ q_{21} & q_{22} & \cdots \\ \vdots & & \\ q_{n1} & \cdots & q_{n,n+1} \end{bmatrix}$$

M*	P	R	Q
n x (n+1)	n x n	n x n	n x (n+1)

M* = matrix of total number of moves originating within the city

P = diagonal matrix of average populations of each sub-area

R = diagonal matrix of propensities to move in each sub-area

Q = matrix of proportions of movers originating in area i who terminate in area j (the row sums of Q equal 1)

Figure 9. A Matrix Representation of Intra-Urban Flows

II, C. This is not the only representation of the movement matrix but it is a useful one in that the relation between the structure of movement flows and the structure of Part I can be readily identified. The set of values r_i corresponds to the discussion of the decision to move, whereas the values q_{ij} are relevant to the discussion of the search for and selection of a new residence. The main task in the subsequent sections is to identify how and why values of r_i vary between sub-areas of the city and values of q_{ij} vary for different origin and destination areas.[5]

Definition of Units of Observation

Before we can discuss specific values of r_i or q_{ij}, we need to know to what observational units they relate.

Two aspects must be considered: the nature of the sub-areas into which the city is divided and the temporal units over which our observations are to be aggregated.

Specification of Sub-Areas

The definition of the set of small areas which is to form the basis of a movement study is one of the most critical steps taken by the researcher, for the *interpretation* of the subsequent analysis must be related directly to this definition.

Effect of Size and Shape: In general, the larger the size and the more circular the shape of sub-areas, the greater will be the proportion of moves which terminate within the area of origin (the values q_{ii} will increase relative to the values of q_{ij}, $i \neq j$). If complete movement records are available which include intra-area moves (see Appendix), the ability to evaluate overall movement rates is not impaired; however, if the data sources only record exchanges between sub-areas, then the larger the sub-areas the greater will be the tendency to underestimate total movement. A further property of size of area is that the larger the sub-areas used, the smaller will be the estimates of net change due to migration in any given time period.

Interpretability of Areal Values: As in all analyses of areal data, we treat the areal units as though they are homogeneous in the characteristics being measured. For some situations, this might be of little concern: for example, in planning expansion or contraction of existing school facilities the net migration of school age children for entire school districts might be of much greater interest than local variations within these districts. However, if we wish to treat movement rates for individual sub-areas as aggregate responses to environmental conditions within each sub-area, we must be more critical. Ideally, we should have pursued a careful prior analysis to identify sub-areas within the city containing similar population-environment profiles, i.e., the sub-areas are relatively homogeneous in terms of the variables in which we are interested. One possible alternative to this approach is to collect data for very small areal units such as blocks, for which we make the assumption that within-block variation in population and environmental attributes is small compared with between-block variation. In other words, if we make our units of observation small enough, we assume that they are homogeneous for all practical purposes.

Unfortunately, in practice we seldom have access to a suitable previous study and the latter procedure does pose computational problems, particularly in larger cities.[6] Usually we are left with two options:

(a) Sub-area definition is based on the experience of individuals living and working in the urban area who are able to apply some subjective notions of "neighborhood" and "functional area" to sub-divisions of the city. The procedure is sounder if a degree of consensus from a number of different individuals can be established.

(b) Data are available for small but relative arbitrary sub-areas such as census tracts. In most cases internal variability of social and demographic characteristics is small relative to inter-area variations, but the student must be sensitive to major inhomogeneities. Although most studies proceed on the basis of this type of data, and many insights can be obtained from such analyses, *great care must be taken in making generalizations about movement behavior without specific reference to the particular areal framework for which data were obtained.*

Specification of Temporal Units

A second decision must be made regarding the temporal units of observation for a movement study. While continuous records create interesting opportunities for a variety of sophisticated analyses (Ginsberg, 1971), most studies specify that movement observations shall be aggregated for particular units of time (a quarter, year, or inter-censal period).

[5] Note that in reality we go through the following steps. (1) we observe the values m_{ij} in M^* and the P_i. (2) we compute $m_{i.}$ by performing the sum $\sum_{j=1}^{n+1} m_{ij}$. (3) the values q_{ij} are obtained from the relation $q_{ij} = m_{ij}/m_{i.}$. (4) the values r_i are obtained from the relation $r_i = m_{i.}/P_i$

[6] For example, there are upwards of 5,000 blocks in the average city of one million people. This would produce a movement matrix with over 25 million cells; if 250,000 persons move in one year, most of the cells would be empty. Computational difficulties derive *both* from the size of the movement matrix *and* the sparseness of the non-zero entries.

If records of all moves are available, the first obvious consequence of increasing the length of the observation unit is that the overall magnitude of entries in the movement matrix increases. This may be an advantage, particularly in the analysis of net changes, which may not be detectable for small intervals of time. However, the longer time period brings substantial disadvantages, particularly for intervals as long as those between successive censuses. Two factors make analysis of movement experience much more complex for longer observation periods:

(a) The other factors to which the movement behavior is to be related (such as local environment, base population, and conditions of the economy at large) do not remain constant. Thus, for many sub-areas, the aggregate behavior will not have a constant reference point.

(b) In attempting to analyze changes due to residential mobility, the assumption that there is no net effect on the area's fertility and mortality experience due to movers may be untenable. Particularly if the effect of mobility is to alter the demographic characteristics of the local population, the resulting effects cannot be ignored.

The main implication of the comments on the definition of observational units is that the student must be careful in drawing conclusions regarding movement behavior in general without reference to the particular framework used for collecting his data. The corollary of this statement is that the apparent contradiction of findings in different studies may not reflect a difference in underlying behavior but a difference in the ways in which the outcomes of that behavior were recorded. The development of a sound understanding of intra-urban migration depends to a considerable extent on the careful design of research procedures which permit the comparison of migration behavior for different observation units in the same city as well as for comparable observation units in different cities. Such procedures lead to the specification of two important properties of movement behavior:

(a) the sensitivity of results to changes in the *scale* of analysis; for example, a specific statement might hold for dwelling units and blocks but not for higher aggregations or, conversely, it might hold for neighborhoods and sectors of the city and break down at the scale of the smallest units.

(b) the degree to which movement behavior analyzed at a given scale exhibits similar properties in different urban areas.

A. The Spatial Distribution of the Propensity to Move

In this section we are concerned with the distribution of the values r_i between the sub-areas of the city. In the Introduction we observed that about 20% of the population of the United States changes residence in the course of a year. For metropolitan areas it is somewhat higher, averaging just under 25%. However, within the metropolitan area the rates vary enormously from one part of the city to another. Most of us are probably familiar with the extremes: inner-city rooming house areas experience mobility rates which often exceed 70% per year, while some of the older (in terms of population as well as housing) suburban communities possess rates as low as 5%. The task of the subsequent discussion is to attempt to fill in some of the detail between these polar types.

In order to obtain estimates of r_i it must be possible to estimate the number of intra-area moves (the values m_{ii}) and therefore comprehensive movement data are necessary. Although most sources possess basic deficiencies, useful data for estimating r_i can be obtained from electoral registers, public utility and school records, city directories and population registers. (See Appendix for a discussion of various data sources.) The amount of effort required to collect a sample of moves which gives a sufficiently wide spatial coverage to extimate r_i for small areas is considerable[7] and therefore there are few studies which have attempted this task.

An early interest in mobility rates was exhibited by the urban ecologists at the University of Chicago in the 1920's. However, their attention was directed mainly at the inner city areas experiencing the full force of the waves of rural-urban and small town-large town migration of the post-war period. Only one or two studies, notably that of Albig (1933), cast their net over the entire urban area; even in these cases the conclusions barely amounted to more than the observation that movement rates tended to decrease with increasing distance from the city center. In the mid-1930's, the mammoth work of H. W. Green using the Real Property Inventory in Cleveland provided a data source in the form of a 321 X 321 matrix of inter-census tract moves which has never been fully utilized (primarily because of the computational problems of handling a matrix of this size at that time). However, it did provide the basis for Stouffer's formulation of the concept of intervening opportunities relating to the distribution of moves from a given origin (see p. 39).

[7] A 10% sample of movers in a given year is barely sufficient to estimate movement rates on a Census Tract basis–for our typical city of one million, this requires the recording of 25,000 separate moves.

Since 1950, although computational ability has greatly increased, the effort required in assembling the raw data has continued to discourage detailed spatial analysis of movement rates. One exception is the study based on electoral register data for a segment of the city of Brisbane, Australia, a city of approximately 600,000 in 1961 (Moore, 1969). This study will be used as an example of the type of patterns encountered, bearing in mind the caveats regarding generalizations voiced at the end of the previous section.

In the Brisbane study, the basic unit of analysis was the census collector's district, which comprised some 1000 persons. One hundred and seventy-one of these units were defined within the study area which comprised the southern part of the city (see Figure 10). The variable subjected to analysis in this study was not the r_i defined above but population turnover t_i, which is defined as "the number of persons leaving residences within sub-area i who are exactly balanced by persons moving into residences in sub-area i; this number is expressed as a proportion of the total population P_i." In essence, the turnover rate is computed by eliminating that segment of total movement which is responsible for net changes in area population. Except for a small number of inner city districts where there is a significant amount of outmigration, the values t_i are very close to the values r_i.[8]

Figure 11 shows the distribution of turnover rates in the southern part of Brisbane for 1961. Two general properties of the distribution are immediately evident. First, turnover rates are much higher in the center of the city (the maximum value was approximately 35% per year) than at the periphery. Secondly, higher values tend to extend further out from the center of the city along the main arterial roads than in the interstitial areas between the arterials. Apart from these trends, little else has immediate impact, for there is a fair amount of variability in rates between adjacent areas. Although we are interested in identifying systematic effects arising from the influence of other variables, there are two other sources of variation which we must recognize.

(a) The data are based on a 10% sample of movers recorded in the electoral register and therefore contain sampling error.

(b) The records themselves contain inaccuracies, and although substantial effort was devoted to deriving correction factors, these inaccuracies still constitute a basic source of error.

1. A Simple Descriptive Model of the Observed Pattern

In order to determine if any further systematic variation exists in the observed pattern of turnover rates, it is fruitful to summarize our observations to this point in a simple descriptive model. We have observed that the rates decline with increasing distance from the center of the city and that higher values extend further out along the main arterials than in interstitial areas. These observations suggest that the rates can be expressed as a simple function of accessibility to the city center, accessibility being measured by some appropriate variable such as travel time. If, in fact, we plot turnover rate against public transport travel time (Figure 12) we find that there is a non-linear relation which can be represented by the equation:[9]

$$t(x) = qe^{-bx} + c \qquad (1)$$

where $t(x)$ is the estimated turnover rate at locations which are x minutes in travel time from the city center: q, b and c are constants. It is stressed that equation (1) is merely a concise *description* of certain aspects of the distribution of turnover rates. It accounts for approximately 60% of the variance in turnover rates in 1961. It does reflect the additional interesting property that the outlying districts, which are the most stable, still experience a turnover rate which averages almost 8% per year.

The question now arises as to the use that can be made of this type of model. Essentially there are three main uses which apply not only to this study but also to a number of other studies which express the variation in a given variable in terms of simple distance or accessibility measures (for example, models representing variation in population density or land values in terms of distance from the city center).

(a) The simple representation provides a statement of a strong association which we need to explain. In other words, it provides a justification for asking the question: "Why does the turnover rate vary as a function of accessibility to the city center?" However, in attempting to answer this question we

---

[8] In terms of the movement matrix, $r_i = \sum_{j=1}^{n+1} m_{ij}/P_i$. If we define Z_i as the smaller of $\sum_{j=1}^{n+1} m_{ij}$ and $\sum_{j=1}^{n+1} m_{ji}$, then $t_i = Z_i/P_i$; thus when $\sum_{j=1}^{n+1} m_{ij} \leq \sum_{j=1}^{n+1} m_{ji}$, $r_i = t_i$. For example, if the population of area i is 1,000 and 250 people leave the area in one year and 300 arrive, the value of t_i is .25. If 300 leave and 250 arrive, the value of t_i is still .25. In the former case r_i = .25, but in the latter r_i = .30. Turnover rates are useful in this type of analysis as they are less susceptible to fluctuations resulting from specific local government decisions relating to urban renewal or other land use conversions.

[9] Other functions might be used (Moore, 1971), but this is appropriate for the present discussion.

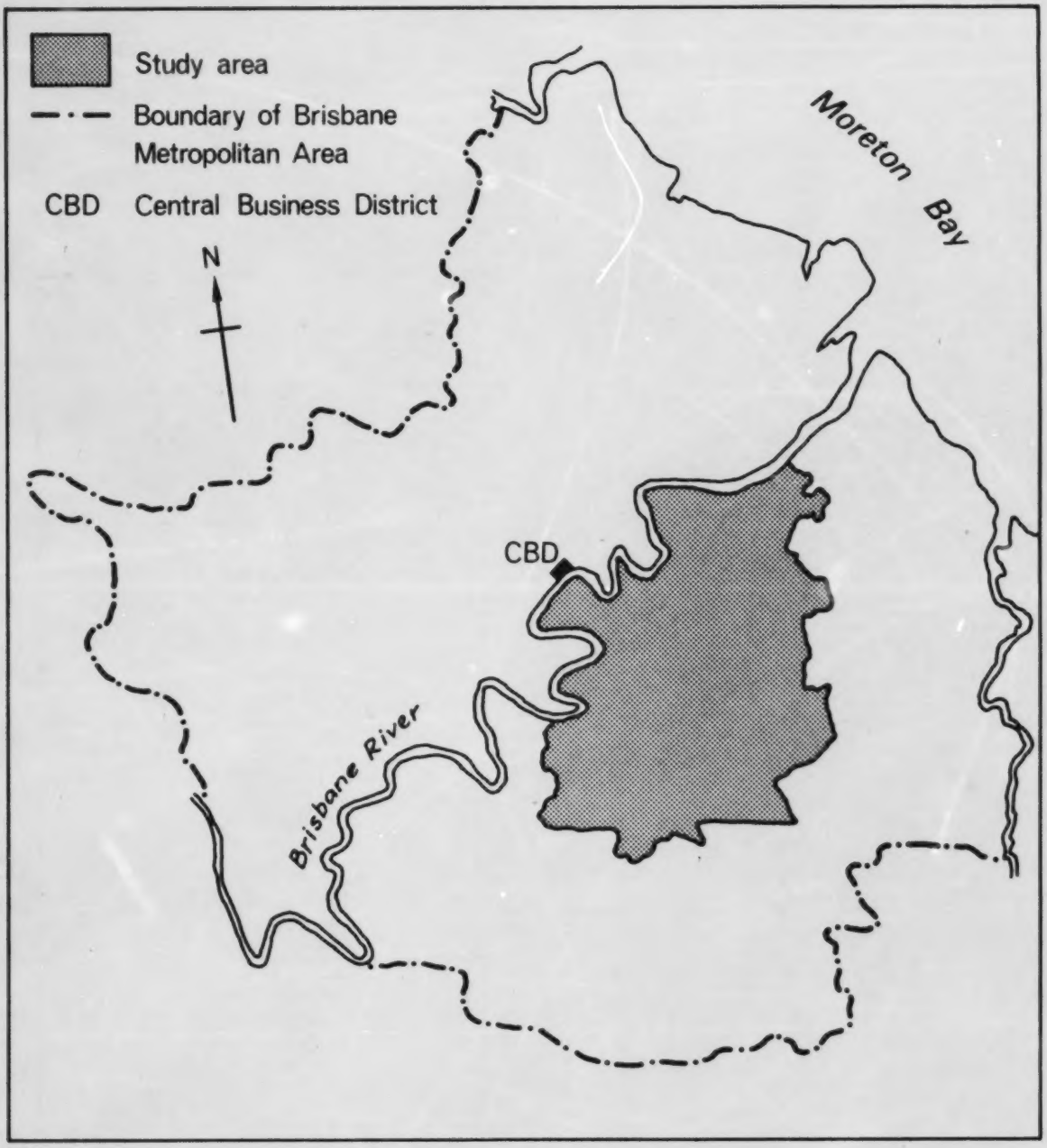


Figure 10. Location of Sample Area Used in Brisbane Study

must not fall into the trap of trying to justify the exact form of equation (1), as there are a variety of simple functions which perform just as well and, if we choose to make the function more complex by adding more terms, we can certainly obtain a better fit to the data.

(b) If we wish to gain insights as to the way in which the pattern of turnover rates varies over time, it is not easy to compare maps such as that given in Figure 11. However, if we fit equation (1) to successive sets of turnover rates, the way in which the parameters q, b, and c vary might suggest

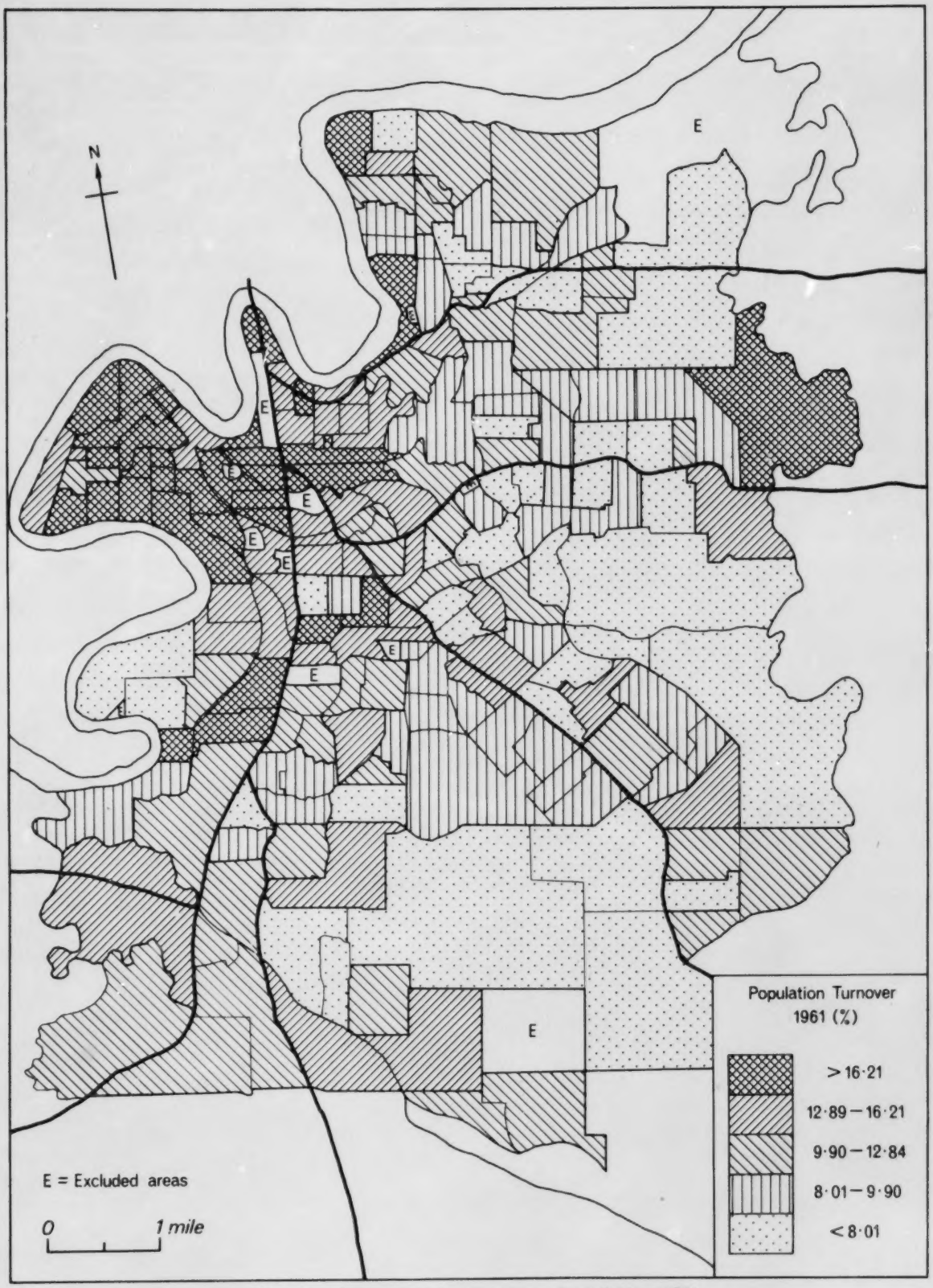


Figure 11. Distribution of Movement Rates–South Brisbane 1961

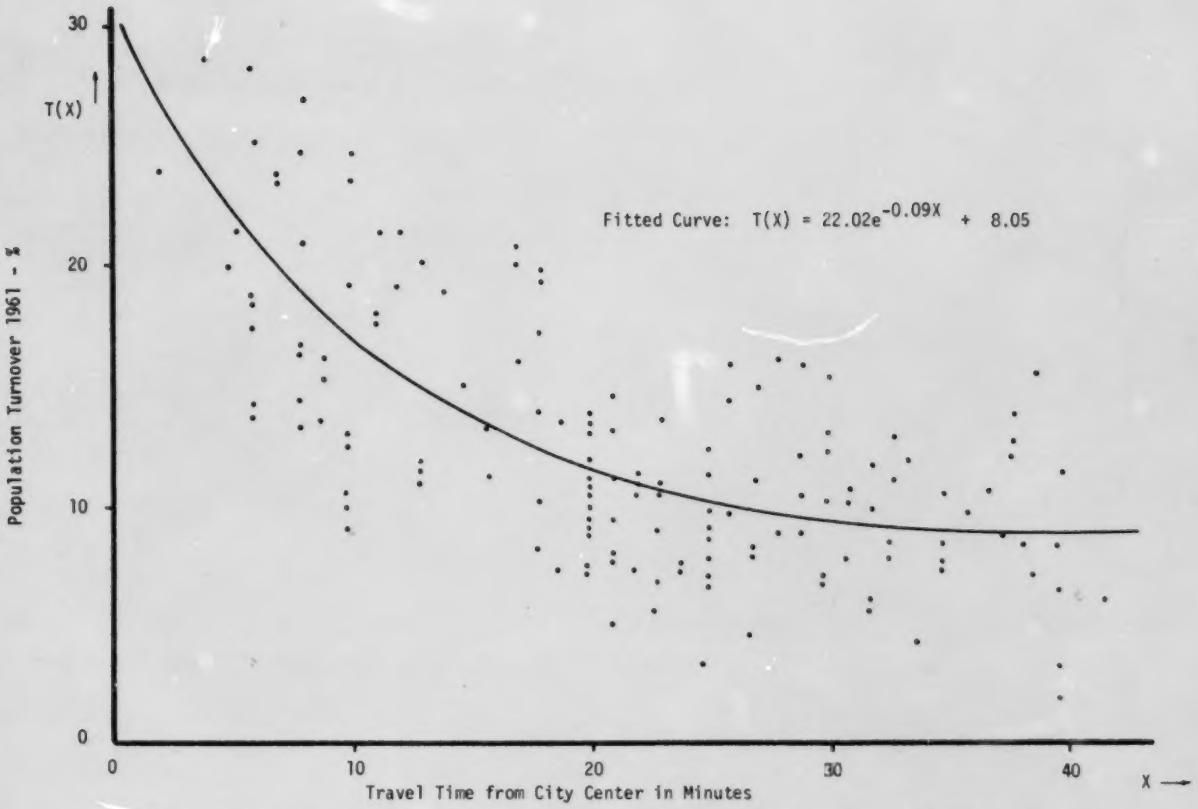


Figure 12 Relation Between Population Turnover Rates for Small Areas and Travel Time to the City Center

hypotheses regarding factors influencing temporal variation in aggregate movement response. For example, in Brisbane it was found that the parameters q and b varied with the availability of credit for new home construction, although the parameter c remained fairly stable over the period 1954–62. The situation is represented in Figure 13; it suggests that as credit becomes difficult to obtain, individuals make temporary adjustments to dwelling needs within the rental segment of the housing market which is located in the inner part of the city of Brisbane. This finding provides a hypothesis which might be tested in other contexts.

(c) Equation (1) identifies a major source of regularity in the data. The ability to identify other systematic sources of variation is enhanced if the major source can first be removed. In other words, we may compute the set of residuals $[t_i^*(x)]$ where

$$t_i^*(x) = t_i - t_i(x) \qquad (2)$$

t_i is the observed turnover rate for area i and $t_i(x)$ is the estimated turnover rate for area i which is at a distance x from the city center. $t_i(x)$ is obtained from equation (1) calibrated for the entire set of observations t_i.[10]

In the Brisbane case, analysis of the values $t_i^*(x)$ revealed a concentration of higher values along the two southern arterials carrying inter-city traffic and lower values along the eastern roads to small communities on the fringe of the metropolitan area. In addition, higher values were found around a suburban industrial area to the south, and lower values were found in a few inner suburbs which developed at low density between the wars and have a large proportion of elderly people.

[10] See Thomas (1968) for an extended discussion of the analysis of residuals.

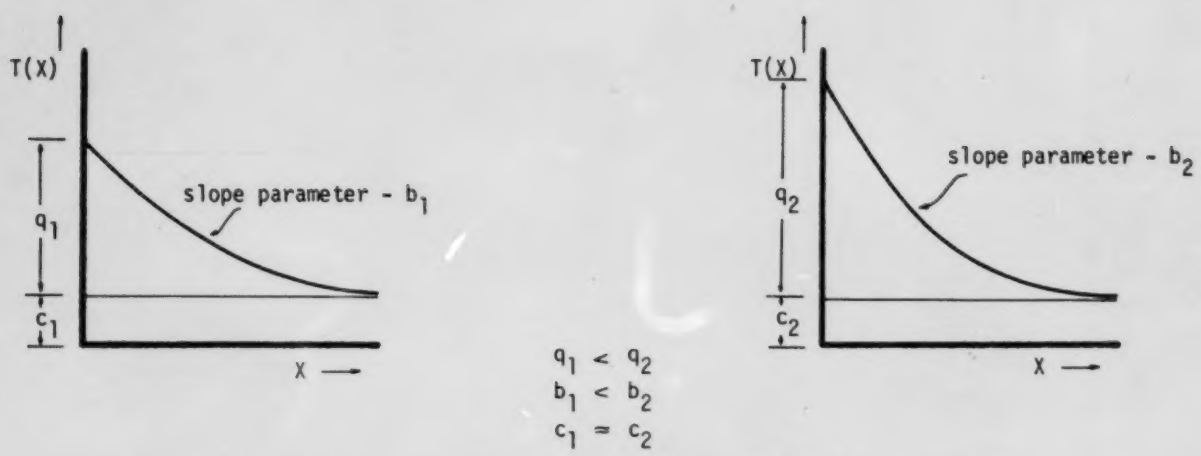


Figure 13. Variation of Parameters of Equation (1) in Brisbane Study for Period 1955-1962

2. Explanation of the Variation in Movement Rates

So far we have described some simple properties of a pattern of movement rates in a specific context. If we wish to explain the distribution of these rates then we must go further and seek to identify the nature of the processes generating the pattern of movement response. Furthermore, we must be explicit as to the phenomena we are trying to explain and the scale at which we are trying to construct an explanation. The traditional chorographic approach in geography is concerned with the processes which generate *differences between* the attributes of the units of observation.[11] However, consider Figures 14a–c.

In Figure 14a, curve A represents the variation in a variable (say population turnover) with increasing distance from the city center at some time t_1. Curve B represents the variation in the same variable at time t_2. The mean value of the two distributions remains the same and, in fact, the total amount of movement in the city may be the same for both time periods. However, the differentiation *between* values at different locations has decreased and the change in the distribution can be explained in terms of processes which generate differences between the units of observation. In Figure 14b, however, the degree of differentiation between values at different distances from the city center has remained the same but the overall magnitudes of the variable values have declined for all locations. In attempting to explain this situation, resort to the processes which generate differences between units of observation will be of little value; we usually turn to processes which affect the entire urban system, such as changes in the health of the regional economy. Of course, in most real situations, we are faced with a combination of both types of change, as depicted in Figure 14c. In this case, our explanations have to be constructed with reference to both types of process.

The most common approach to the explanation of areal variation in movement propensity has been to apply standard correlation and regression procedures to areal data for movement rates and for selected socio-economic and demographic variables. For example, we might use the discussion of the "decision to move" in Part I to formulate the following propositions regarding aggregate movement patterns for the Brisbane example:

P1 : the greater the number of young dependents in an area, the lower will be the population turnover.

P2 : the higher the proportion of single adults in an area, the higher will be the rate of population turnover.

P3 : the higher the proportion of dwellings which are

[11] Variation in individual behavior is generally much greater than that between areas, for the variation between areas ignores all the variation between individuals within the area. Unless the latter is zero, the variation between areas must be less than the total variation between individuals.

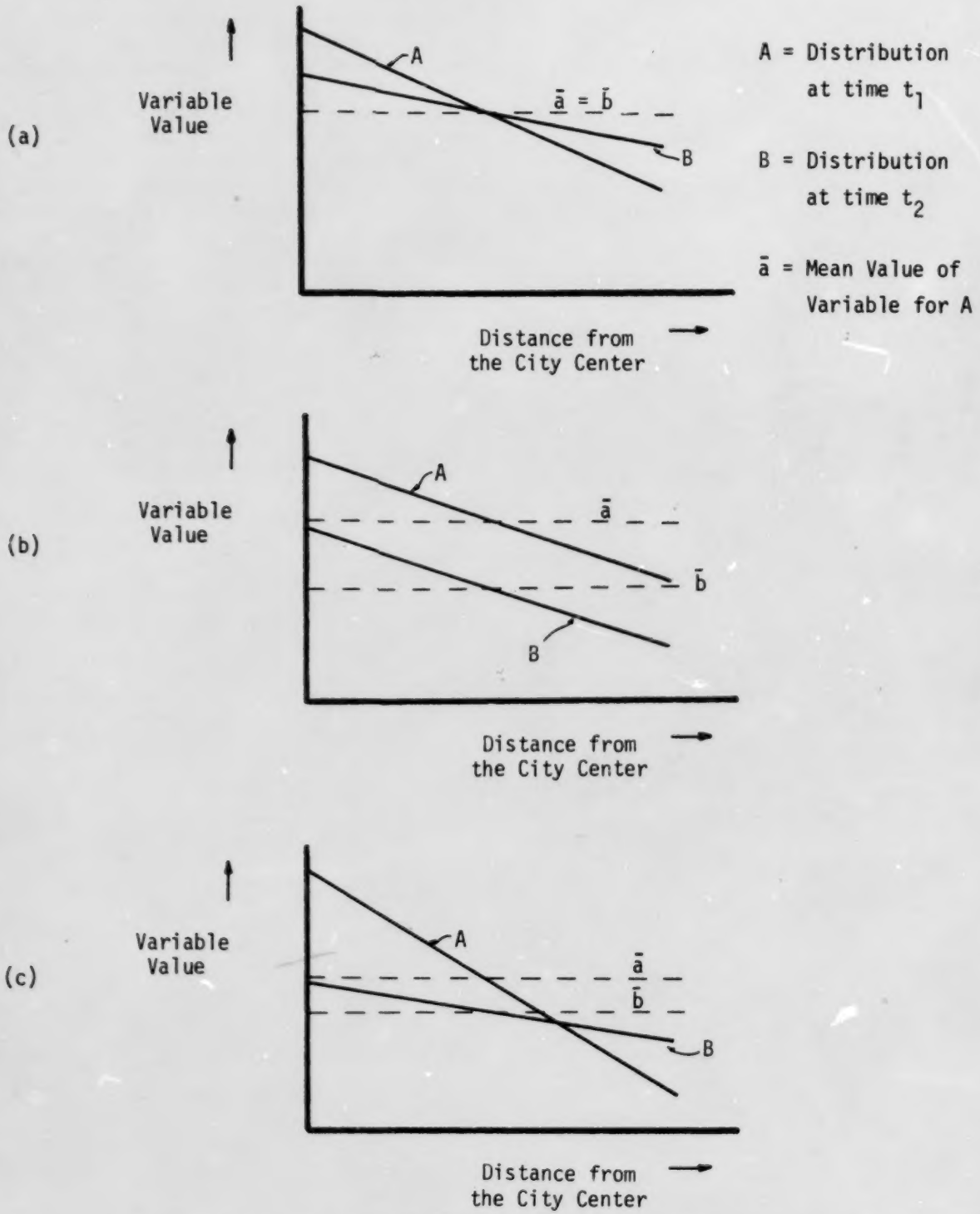


Figure 14. Three Examples of Temporal Variation in the Spatial Distribution of an Ecological Variable

single family units, the lower will be the population turnover.

P4 : the higher the proportion of dwellings in an area which are owner-occupied, the lower will be the rate of population turnover.

P5 : the higher the proportion of the population who are Australian-born, the lower will be the population turnover.

The correlations obtained in the Brisbane study were consistent with each of these propositions (Moore, 1971). However, just as our individual correlations need to be interpreted, so do our ecological correlations.[12]

In the Brisbane example, we find that all of the associated variables used in the propositions are strongly correlated with accessibility to the city center (Table 6). This situation reflects the simple nature of many aspects of the spatial structure of the city, a structure which is repeated in many small and medium-sized cities throughout the western world. Stegman (1969), for example, suggests that it is not until a city approaches the three-quarter million mark that there is a strong tendency for this simple structure to develop into a more complex multi-nuclear form. The implication is that the very simplicity of the socio-economic, demographic, and housing structure of such cities leads to the effectiveness of descriptive models like equation (1). Once the structure becomes more complex, we must look to models which more readily reflect an understanding of the antecedents of movement behavior itself. Unfortunately, in trying to do this in Brisbane, we run into another problem; the high degree of intercorrelation between the variables makes it very difficult to distinguish between the correlates of movement response in terms of which variables are the most important in influencing movement behavior. This situation arises very frequently in urban analyses and much fallacious argument has been developed on the basis of high correlations between variables exhibiting similar patterns of declining values with increasing distance from the city center.

Essentially we have accomplished two things in the course of the correlation analysis.

(a) We have provided a more comprehensive description of the conditions in which high and low mobility are found in Brisbane by identifying those attributes which co-vary with population turnover.

(b) The observed correlations are all consistent with the discussion in Part I. In this sense we might claim that the correlation analysis added support to our understanding of the variation in movement rates throughout the city.

A basic deficiency of the type of analysis we have presented in the previous paragraphs is that it is both static and concerned with form rather than with process. We are interested in a number of aspects of mobility: (1) as a

[12] The interpretation of ecological correlations (correlations obtained from areal data) poses several problems which are beyond the scope of this paper. For the more advanced student, many aspects are discussed in Dogan and Rokkan (1969).

TABLE 6: CORRELATIONS OF FIVE SOCIO-ECONOMIC VARIABLES WITH POPULATION TURNOVER IN THE CITY OF BRISBANE, AUSTRALIA

Variable Correlated With Population Turnover	*Predicted Direction of Correlation*	*Observed Value of Correlation*	*Correlation of Variable With Distance to City Center*
X_1 : Dependency ratio	–	–0.533	+0.822
X_2 : Percentage of adults who are single	+	+0.570	–0.656
X_3 : Percentage of dwellings which are single, private units	–	–0.718	+0.856
X_4 : Percentage of dwellings owner-occupied	–	–0.210	+0.655
X_5 : Percentage of population who are Australian-born	–	–0.666	+0.700

Source: Primary Data

response to neighborhood conditions, (2) as the mechanism for maintaining or changing the characteristics of the neighborhood population, and (3) as a reflection of the changing milieu for the individual. Our simple analysis of form does not allow us to make many inferences about these ongoing processes.

A fruitful way to gain insights into the dynamic aspects of residential mobility is to consider the linkages between the mobility characteristics of urban neighborhoods and the change in their socio-economic and demographic characteristics. These linkages depend, to a large extent, on the residential functions being served by the particular neighborhood: we expand these ideas with reference to the table given in Figure 15.

Typical situations are presented for each cell of the table; these situations are meant to be illustrative rather than exhaustive. The framework is meant to be an aid to discussion rather than a rigid classification. In fact, the particular cell in which we place a neighborhood depends very much on which population characteristics are the focus of our attention. For example, a process which leads to a rapid change in the ethnic composition of a neighborhood may leave the age distribution virtually unaltered. With this comment in mind, we recognize four types of relation between mobility and change in population characteristics.

Type I–High Mobility and Neighborhood Change

We have a tendency to associate high population mobility with neighborhood change but, in fact, Type I situations are probably substantially less common than Type II, primarily because the latter usually persist for a considerable time whereas the former are a temporary phenomenon.

The most common example of this first type is that

	Neighborhoods Experiencing Change in Selected Population Characteristics	Neighborhoods Experiencing Stability in Selected Population Characteristics
Neighborhoods Experiencing High Mobility	I a) Rapid Change resulting from ethnic, social or racial conflict within area b) Change resulting from area being assigned high social value by specific subgroup c) Change resulting from rapid deterioration of physical environment (particularly due to location of public facilities	II a) Inflexible housing catering to small range of household types b) Neighborhood is a transit point for in-migrants from rural and from other urban areas
Neighborhoods Experiencing Low Mobility	III a) Flexible housing catering to many household types. Slow aging of population and selective outmigration by age b) Deteriorating housing with selective inmigration by socio-economic status	IV a) Tightly structured social networks, particularly for ethnic communities, tie individual to neighborhood

Figure 15. Typical Situations Linking Mobility and Population Change at the Neighborhood Level

represented by expansion of black neighborhoods (Morrill, 1965; Rose, 1969), or more generally by the spread of a population sub-group into an area occupied by another group with conflicting values, behaviors, or prejudices. In this situation, the first occurrence is an increase in the turnover rate among the "invaded" group; members of this group still move into the area, but duration of residence rapidly becomes shorter. When the composition of the neighborhood reaches a critical stage (the "tipping-point" in the black-white situation occurs when approximately 25% of the area becomes black–Wolf, 1963), the rate of transition becomes very rapid until the neighborhood becomes dominated by a single group once more. During the transition, movement rates reach 40–50% per annum, or even higher, but subside again subsequently.

A second example of the Type I situation is familiar to most of us but has received little research attention. Many years ago, Firey (1946) observed that the value assigned to a particular segment of urban space depends on the actions and values of the group which occupies that space. We may extend this argument to cover the case in which a neighborhood suduenly acquires a high social value for a particular segment of the population–it becomes the "in place to live." Most commonly this situation occurs in inner city areas with a high degree of accessibility to entertainment and to other amenities. Particularly, if the group to which the neighborhood becomes desirable is relatively affluent (as was the case in the Chelsea area of London), the rapid rise in house prices can exert considerable economic pressures on the remaining households and result in high levels of mobility during the period in which the socio-economic and demographic character of the neighborhood changes.

A third type of situation in which high mobility and population change are experienced is that in which the neighborhood suddenly becomes undesirable to the inhabitants because of changes in the physical environment. In particular, the decision to locate large public facilities such as an expressway or an airport runway near a residential neighborhood may depress values in the neighborhood to such an extent that a high leaving rate is induced, with the subsequent in-migrant population coming from a lower income group.

Type I–High Mobility and Population Stability

In many instances a high "through-put" of population is required in order to maintain the character of a particular neighborhood (Cave, 1969). In large part this is found in areas in which the housing is relatively inflexible in the sense that it can only cater for the needs of a specific sub-group of the population. Typical are the in-town districts characterized by small rented apartments suitable for one and two-person households of moderate income. Most commonly they are occupied by young single or newly married couples. At this stage of the family life cycle, changes in status are frequent and, particularly when children are born, there is considerable pressure to move to a dwelling (usually in suburban areas) which is more suited functionally to the new situation. The new occupant of their old home is likely to be another one or two-person household; thus a high level of mobility is experienced in maintaining the well-defined character of the neighborhood.

Those parts of the city which serve as receiving areas for in-migrants from rural districts or from other urban areas provide a second example of Type II neighborhoods. The housing market is geared to the temporary tenant; often, the poorest of these areas serve as a human filter, retaining those who fail to adjust to the new urban environment and letting the more successful pass on to other parts of the city. Most extreme of these areas is the "skid row" typified by high proportions of single adult males, few children, and high levels of unemployment. This type of area has received perhaps more attention than any other from students of mobility in urban neighborhoods, particularly in the early days of urban ecology (see Theodorson, 1961, for several examples).

Type III–Low Mobility and Change in Population Characteristics

For areas experiencing low mobility, we encounter an interesting situation. One of the important characteristics of the population is its age distribution: if mobility is low, a strong ageing effect often emerges. In fact, we can virtually never find anything approaching a stable population within the urban area and, on these grounds, we could argue that Type IV neighborhoods (low mobility and stable population characteristics) do not exist. However, it is also fruitful to talk about neighborhood stability in terms of attributes other than age, such as socio-economic or ethnic characteristics. This provides us with a rationale for discussing Type III and IV neighborhoods separately.

Low mobility and gradual change in characteristics of the neighborhood is probably the most widespread condition in the majority of urban areas. Basically we can distinguish between two types of change depending on whether selective out-migration or in-migration predominates.

In contrast to the situation for one and two-person apartment areas, the majority of single-family suburban homes possess greater flexibility in terms of being able to accomodate changes in size and economic status of their

occupants. Coupled with the predominance of owner-occupied over rented units in this housing category, this situation leads to lower mobility rates. One consequence is that these neighborhoods are characterized by a gradual ageing of the population (at some point they also become associated with declining densities as older children leave the parental home). In part, ageing reflects a duration of residence effect (see Part I, A, 2, (b)) in which the longer a person has dwelt in the area, the less likely he is to move. Thus the propensity to move tends to decline with age of the residents, and the out-movement rate is selective with regard to age.

A second widespread situation associating low mobility and gradual change arises as a consequence of ageing and deterioration of housing. As this process continues, the structures often become less desirable for the occupant group. While this may lead to out-movement in all segments of the population in the neighborhood, in-migration shifts progressively toward lower socio-economic groups, such that there is a downgrading in the overall socio-economic characteristics of the area. This process is often referred to as that of "filtering down of residential vacancies" (Grigsby, 1963; Smith, 1970).

Type IV–Low Mobility and Stability of Population Characteristics

Here we focus on specific population characteristics other than age. Type IV neighborhoods find their strongest expression in the tightly knit ethnic neighborhoods found in the inner districts of many large cities, although one can regard many affluent white suburbs in similar light. Since the cultural attributes of the ethnic group form a very strong attraction for the members of that group *and* a similar environment cannot be found elsewhere in the city, there is little incentive to move, particularly for the older members of the group. Often, successful members of the community will knock down a structure and build anew *within* the neighborhood rather than follow the trend toward the suburbs of the population as a whole. Documentation of these situations is extensive, the best known being the writings of Gans (1968, Ch. 15) and Jane Jacobs (1961) regarding the Italian community of Boston's West End.

Although most frequently linked with ethnic neighborhoods, there is some evidence that a similar situation can arise when intensive patterns of social networks form in local areas and serve to bind households to the neighborhood even though the physical characteristics of the area may be unattractive. (See, for example, Young and Wilmott's 1957 study of families in the East End of London.)

The actual level of mobility and associated rates of change are subject to much local variation as a result of external influences and regulatory factors which we have omitted from the discussion. However, most of these factors are little understood, particularly in terms of their spatial impact. We suggested that, in Brisbane, the availability of credit for new home construction affected movement rates, stimulating increased levels of movement in the rental segment of the market. We need to know if this phenomenon is observable elsewhere. It is well known that the rate of change in the racial composition of neighborhoods is influenced by the activities of real estate operators; in particular, very high levels of turnover are associated with "block-busting" or "panic-peddling" activities of realtors in racially changing neighborhoods in inner suburbs of many large cities (Simmons, 1968). The granting of rehabilitation grants for structures in areas of deteriorating housing will tend to reduce levels of out-movement, whereas we have noted the tendency of turnover rates to increase when new public facilities such as an expressway are proposed for residential areas.

Most neighborhoods in the city fall into categories II, III, and IV of our classification. This has the useful property that the processes of slow ageing, structural deterioration, and stability of certain population characteristics can be easily projected to give reliable short-run predictions of neighborhood characteristics. Further, some aspects of the spread of ethnic groups can also be predicted if we confine ourselves to peripheral expansion of existing areas. In combination these processes form the basis of projections for most planning studies in U.S. cities. However, the sudden changes typifying Type I situations cannot be predicted with any degree of confidence. While we recognize that such changes take place and we can identify the general type of area in which such changes might occur, we cannot be confident as to the specific areas which will experience rapid change. The implication is that we need to develop sensitive information systems which can detect early signs of rapid change as well as models which will predict the more gradual and persistent short-run changes which characterize the majority of the urban area.

3. Overview

To obtain some understanding of the impact of intra-urban moves on the residential structure of urban neighborhoods, we need to establish a framework for organizing our observations. In this paper, we have represented moves in an origin-destination table whose entries (the m_{ij}) are considered as a product of three values: the population of area i (P_i), the propensity to move of the residents of area i (r_i), and the proportion of moves originating in area i which terminate in area j (q_{ij}).[13] The previous section is concerned with variation in the values r_i.

A case study in Brisbane, Australia, showed that a simple model describing the non-linear decline of movement rates with increasing distance from the city center accounted for a major part of the variation in inter-area movement rates (60%). However, the main function of these simplistic models is not to reproduce the detail of reality. We can use such models to compare changes in the main features of the pattern of movement rates over time for the same city or to compare different cities at the same point in time (provided the observational frameworks are compatible). We can also use these simple models to remove major trends and thereby facilitate the search for systematic local effects. In the Brisbane case, the latter procedure emphasized increased movement rates along main arterial roads, particularly in the vicinity of industrial areas.

Attempts to provide an explanation for variations in movement rates have mostly followed the path of correlation and regression analysis. Although such procedures can be useful when interpreted within some prior theory of movement behavior, they have seldom led directly to new insights regarding mobility. In part this stems from the arbitrary areal frameworks which have provided the data bases for many studies, in part from the high degree of intercorrelation between mobility and other socio-economic and demographic variables (particularly in single nucleus cities), and in part from the difficulty of formulating theoretical statements appropriate to the scale of the analysis.

Perhaps the greatest need at the present time is to develop a more rigorous approach to analyzing the processes relating mobility and residential change in urban neighborhoods, processes for which we have some intuitive feeling derived from biographical studies of particular neighborhoods. The processes of invasion and succession in ethnically changing areas, the filtering down of vacancies to groups of lower socio-economic status, the ageing of suburban populations, and mechanisms by which certain districts retain their socio-economic or demographic attributes, at least in the short run, have been identified. However, the factors which regulate the spatial and temporal magnitude of these processes, the factors which accelerate racial change, slow the deterioration of inner city structures, and control the out-movement rate in apartment areas need to be the subject of more critical analysis if our present level of understanding is to be extended.

B. The Spatial Structure of Inter-Area Flows

Attention now turns to the destinations of moves and particularly to the distribution of destinations for specified origin areas within the city. In terms of Figure 9, we are interested in the analysis of the values m_{ij} and q_{ij} for each row in the matrices M^* and Q.

Consider a particular empirical matrix and the mapping of selected rows of that matrix (Figure 16). Several points are immediately evident.

(a) The moves exhibit strong distance biases in that a large proportion of moves are terminated within the area of origin and, in general, the intensity of interaction decreases with increasing distance from the origin area.

(b) Moves tend to be concentrated in the sector of the city in which they originate.[14] This characteristic becomes stronger as one goes away from the city center (a natural consequence of the sector itself becoming physically larger: see Figure 6).

(c) Although there are counter flows for every flow, moves tend to be biased away from the center. This reflects a net suburbanization for individuals living in the city, although the total movement effect may not be the same, as patterns of in-migration from other regions may substantially favor the inner part of the city.

(d) A sizeable proportion of moves go out of the city altogether. The value varies somewhat from one city to another, but would seem to be about 20% for most medium-sized cities. The value probably decreases somewhat with increasing city size,[15] and the value is certainly responsive to the definition of the city boundary; the value will be smaller if peripheral development is taking place within the defined boundary rather than in administratively separate but adjacent suburban communities.

1. A Model of Inter-Area Flows

In this section we shall adopt a different strategy from that contained in the discussion of movement rates. Instead of combining our broad observations into a simple descriptive model, we will return to the statements of Part I regarding the "search for and selection of a new residence;" from this discussion we will develop a simple model and evaluate the extent to which it is consistent with our observations.

In the discussion of individual behavior we argued that

[13] Other representations are given in Rogers (1967) and Ginsberg (1971).

[14] In this context, the term sector is used to mean the wedge-shaped segment whose apex is at the center of the city and which is centered on the radial through the origin area from the city center.

[15] Although it is debatable that there is an upper population level beyond which the pressures exerted upon the individual living in a large metropolis encourage an increased rate of out-migration.

a) The Movement Matrix

Origin Areas	Destination Areas 1	2	3	4	5	6	7	8	9	10	11
1	81	55	33	15	17	11	13	18	17	14	27
2	36	68	5	18	13	7	11	18	16	18	14
3	18	16	48	23	18	21	11	7	34	22	19
4	15	17	12	39	9	10	27	11	38	28	12
5	4	11	10	9	33	28	13	6	12	14	4
6	9	5	1	6	15	48	5	3	11	8	16
7	4	7	7	19	4	14	28	8	21	11	7
8	12	18	9	16	0	6	2	35	30	14	33
9	4	7	6	7	1	2	9	6	31	26	16

Source : 10% sample from Electoral Registers

b) Key to Origin/Destination Areas (see Figure 10 for Location of Study Area)

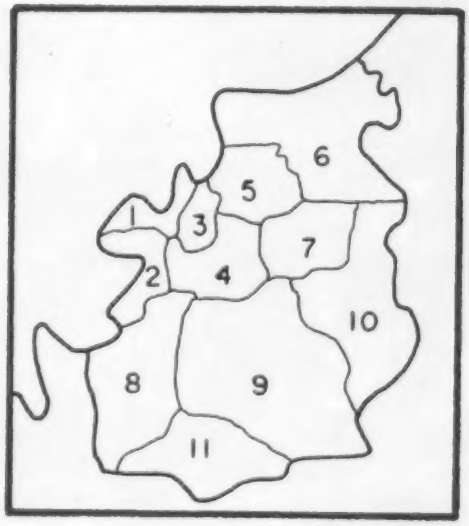
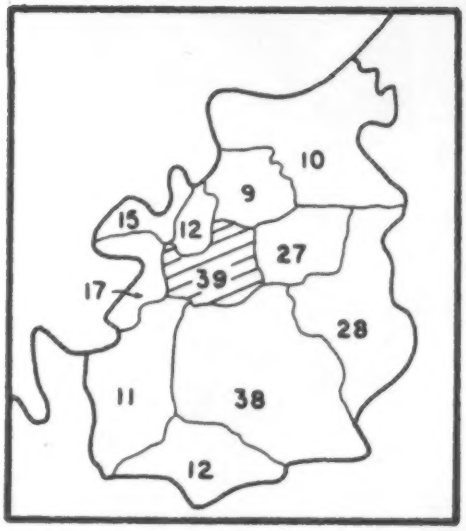


Figure 16. Inter-Area Movement Matrix–South Brisbane 1960-2 and Mapping of Selected Rows

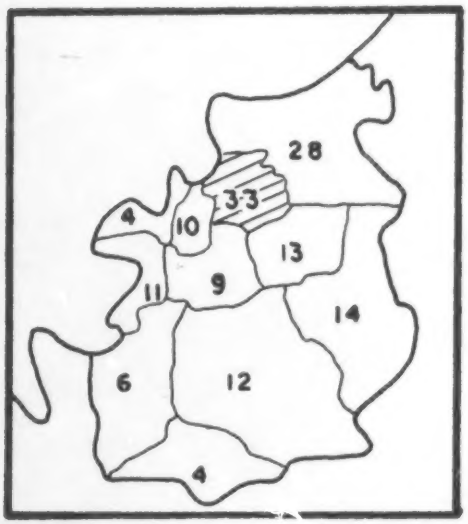
c) Mapping of Selected Rows (Origin Areas are Shaded)

Origin Area 1

Origin Area 4



Origin Area 5



Origin Area 8

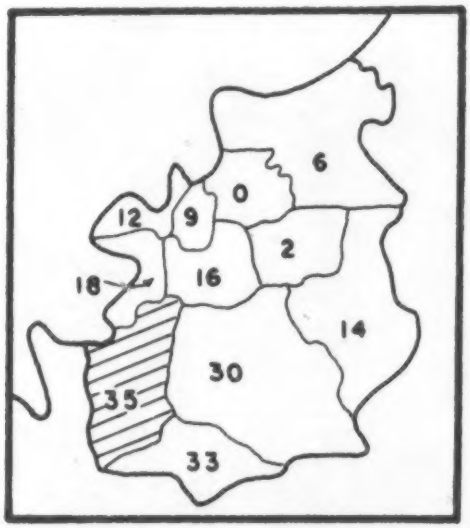


Figure 16. Inter-Area Movement Matrix–South Brisbane 1960-2 and Mapping of Selected Rows

the particular destination chosen by the household depends in large part on three factors:

(a) the nature of the information about the characteristics of the urban area possessed by the individual
(b) the distribution of vacancies acceptable to him
(c) the costs, both financial and psychological (such as those resulting from disruption of patterns of daily life) which follow from a given move.

The Mathematical Structure: In order to make use of these statements we must make some further assumptions. We shall use the following:

A. The probability of an individual finding a suitable vacancy in area j depends on the number of suitable vacancies in area j at the time he is searching. Let this number be v_j. The individual responds to some function of this value which we shall specify as $f(v_j)$.
B. Both the decrease in the quality of information regarding neighborhood characteristics and the perceived increase in costs of moving from i to j depend on the degree of accessibility existing between areas i and j. Let us call this value a_{ij} and the value to which the individual responds $g(a_{ij})$.
C. The probability of moving to area j given that one starts in area i is a simple combination of the relations indicated in A and B.

Using the symbols defined above we can provide expressions for the values q_{ij} and m_{ij} in our model:[16]

$$q_{ij} = kf(v_j)\, g(a_{ij}) \tag{3a}$$

and

$$m_{ij} = P_i r_i\, kf(v_j)\, g(a_{ij}) \tag{3b}$$

where k is a constant which ensures that $\sum_{j=1}^{n+1} q_{ij} = 1$. In order to make use of equations 3a and b, we must

a) provide operational definitions for v_j and a_{ij}
b) specify the forms of $g(a_{ij})$ and $f(v_j)$.

Definition of Vacancies: If we pursued our earlier discussion we should define acceptable vacancies v_j for a particular population sub-group as those vacancies whose attributes fall within the ranges of acceptability for members of that group. Because of the vast number of criteria which can be used by individuals, this is impracticable and we must make further simplifying assumptions. The simplest of all is to assume that the population is homogeneous and all vacancies of equal quality, in which case the number of vacancies occurring in area j in a specified time is

v_j = (number of households leaving dwellings in area j) + (number of new dwelling units constructed) − (number of dwelling units demolished).

If we wish to make more sophisticated statements about the types and locations of vacancies, we have to know more about the nature of the relation between population characteristics and the dwelling attributes they select. Our earlier discussion suggests this is a probabilistic rather than a deterministic relation, and would have to be modelled accordingly. However, for the moment we will proceed with our assumption of homogeneity.

Definition of Accessibility: Accessibility can be defined in a number of ways:

(i) *as simple airline distance* between the center of area i and the center of area j. This is not as crude as it seems, for other measures, which, at first sight, possess more behaviorally meaningful definitions, are often so highly correlated with airline distance that the substitution of the latter does little harm to the subsequent analysis. For example, Nordbeck (1964) identifies a very strong and consistent relation within cities between airline distance and distance over the road network.
(ii) *as road distance, travel cost, or travel time.* The last is of particular interest as it is time taken to undertake a journey rather than the physical distance (or even the cost) which exerts the strongest effect on the decision to make a trip within the city.
(iii) *as the number of intervening opportunities between area i and area j,* a third definition of accessibility due to the sociologist Stouffer (1940, 1960). He argued that the main determinant of whether an individual would select an opportunity at a given distance from his present residence was not the distance itself but rather the number of intervening opportunities between the individual and the potential destination. Although this formulation has conceptual appeal, it imposes an additional requirement that we provide an operational definition for "intervening opportunities." Stouffer (1960) solved this problem in a somewhat arbitrary way by defining intervening opportunities as those opportunities which lay within a circle of radius d_{ij} centered at i (where d_{ij} is the airline distance between i and j). He also presented a second

[16] m_{ij} is the total number of movers going from i to j; q_{ij} is the conditional probability of moving to j given that the move originated in i; see page 22.

definition: those opportunities lying within a circle of diameter d_{ij} centered at the mid-point of the line from i to j. Neither of these definitions is appealing; however, if we attempt to produce a definition which has a sounder behavioral base, we return to the notion of perceived opportunities and the availability of information regarding vacancies. The resulting structure would probably be similar to the one we have adopted in equation (3).

Definition of Forms of $f(v_j)$ and $g(a_{ij})$: There are a large number of possible forms for both $f(v_j)$ and $g(a_{ij})$.[17] In the case of the former, the simplest assumption is that the individual responds directly to the total number of vacancies in area j such that $f(v_j) = v_j$. With regard to accessibility, the simplest assumption is that the attenuation effect on both information availability and removal costs is directly related to the inverse of the accessibility measure such that $g(a_{ij}) = a_{ij}^{-1}$. We now have that

$$q_{ij} = k v_j a_{ij}^{-1} \tag{4}$$

If k is a normalizing constant such that $\sum_{j=1}^{n+1} q_{ij} = 1$, we see that

$$k = \sum_{h=1}^{n+1} v_h a_{ih}^{-1} \text{ (footnote 18)} \tag{5}$$

and

$$m_{ij} = k P_i r_i v_j a_{ij}^{-1} \tag{6}$$

Equation (6) is very similar to the gravity model so frequently used in studies of spatial interaction (Mayer, 1969) in which[19]

$$m_{ij} = k P_i P_j d_{ij}^{-b} \tag{7}$$

where k = constant

P_i = population of area i
P_j = population of area j
d_{ij} = measure of distance between i and j
b = parameter reflecting the attenuation effect of distance.

The use of an exponent b rather than unity is a more general way of expressing $g(a_{ij})$. In order to equate the other aspects of equations (6) and (7) we would have to make the further assumptions

(i) the out-movement rates r_i are constant
(ii) the vacancies v_j are directly proportional to the population P_j.

Based on our earlier discussion of movement rates and our general experience regarding the distribution of new development, we would not expect these simplifications to be very fruitful in most studies of intra-urban change of residence.

Application of Equations (4) and (6): One further problem faces us in the use of equations (4) and (6)—the values q_{ii} *and* $q_{i,n+1}$ are not readily derived within the context of the model. Consider the value q_{ii} (the proportion of moves originating in area i which terminate in the same area). Most areas are irregular in shape, and we cannot obtain a very good measure of the average accessibility between points within the area (a_{ii}). In the case of those moves moving out of the city altogether $(q_{i,n+1})$, we cannot provide reasonable values for either v_{n+1} or $a_{i,n+1}$. The consequence is that we must obtain independent empirical estimates for these two values for each sub-area and then apply equation (6) to the moves from area i to the *other* n-1 areas within the city.[20]

Given these caveats, the ability of equation (4) to reproduce general patterns of inter-area flows within the city is good, provided suitable definitions are provided for vacancies and for accessibility.[21] However, as it stands, the model is too crude to serve as a useful predictive device in most planning contexts; in particular, it possesses little sensitivity with regard to net flows between sub-areas. As an example we might have the situation in which each individual flow can be estimated to within 5%, but the difference between the estimated inflow and the estimated outflow might be a very poor estimate of the actual net change in population due to migration.

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[17] See Olsson (1965) and Morrill (1963) for extensive discussions on this point, particularly regarding the forms for $g(a_{ij})$.

[18] 'h' is merely an index which runs over all destination areas.

[19] Note that in the usual application of the gravity model, it is total flow rather than directed flow which is being modelled (i.e., $m_{ij} + m_{ji} = I_{ij}$).

[20] This step requires an adjustment in equation (5) such that the normalizing constant k is now given by

$$k = \sum_{\substack{h=1 \\ h \neq i}}^{n} v_h a_{ih}^{-1} \text{ and}$$

$$\sum_{\substack{h=1 \\ h \neq i}}^{n} q_{ih} = 1 - q_{ii} - q_{i,n+1}$$

[21] For example, in the Brisbane study, equation (6) accounted for about 70% of the variation in flows between sub-areas of the city.

2. Extensions of the Model

We may proceed in two directions in making use of the model as it stands. Either we may compare its predictions directly with empirical observations to gain insights into the major deviations from the model or we may attempt to develop the model structure further.

The nature of the discrepancies between a model such as that represented by equation (4) and actual observations can often prove enlightening. For example, in the model, all opportunities are assumed to be equally available to all movers; if, however, one group is discriminated against, the pattern of deviations for particular origin areas will exhibit substantial biases. Patterns of out-migrations from an inner city black neighborhood would exhibit a much greater short-distance concentration than would be the case for out-migrations from an inner city white neighborhood. As a second example we note that the degree of sectoral concentration generated by the model is sensitive to the measure of accessibility; in the Brisbane study, the use of public transport travel time which has a sectoral orientation (resulting from the pattern of transit lines) produced a movement pattern which was closer to the observed pattern than when car travel time was used. Finally, the analysis of the residual flows serves to highlight the more specialized aspects of the flow patterns such as the specific links between lower income inner and outer suburbs. Thus, in comparing a simple model directly with real data, it is often the discrepancies rather than the degree of fit which are of major interest and which form the basis for developing and refining the model.

A second approach is to develop the model from a theoretical viewpoint. Essentially two main trends in the literature can be identified.

(a) The components of equation (3) can be more critically evaluated. The total population can be disaggregated into sub-groups which express different needs and preferences for housing and separate sub-models can be formulated for each group. In particular, the set of vacancies can be made group-specific such that all vacancies are not equally attractive to all members of the population. The main problem arises, of course, in that most movers will find not one type of dwelling but a range of dwelling types acceptable although they would express preferences between these types. This demands a probabilistic approach to the problem and, as yet, relatively little progress has been made. (Wilson, 1969 provides an approach to the disaggregation of the population.)

The second aspect of equation (3) which can be developed is the treatment of the accessibility function. It was suggested that the response to accessibility reflected a number of more basic factors, namely the acquisition of information about a vacancy, and the perceived economic and psychological costs of movement. These component parts can be modelled directly: even the information gathering process can be broken down into constituent parts in which different sources such as personal contact, mass media, and special agencies can be dealt with separately. Brown and Moore (1970a) discuss some of the general aspects of this problem and Morrill (1963) provides a review of different forms of the function $g(a_{ij})$ which might be used in equation (3).

(b) There is an altogether different aspect of the use of equation (4) which demands attention. The model merely assigns households to areas on the basis of a given function of vacancies and accessibility. However, there is no guarantee that the total number of movers sent to area j from all other areas within the city will not exceed the total number of vacancies in area j. In other words we would like to incorporate *constraints* into our model such that this overassignment is impossible. We might also like to introduce a *cost* constraint such that the cost of all moves does not exceed a certain specified figure. These constraints eliminate some obvious inconsistencies arising in the model output and make the comparison of that output with empirical observations more meaningful. However, the resulting mathematical structure is more complex and beyond the scope of this paper. The interested student is referred to the recent work of Wilson (1969, 1971) for a more comprehensive discussion.

3. Overview

As in all model-building efforts, equations (4) and (6) are a substantial simplification of real world conditions. However, it is important to understand the ways in which reality is simplified and the resulting implications for further research.

The model developed in the previous section is a statement regarding the *general structure* of flows resulting from intra-urban changes of residence. In some ways, this is a less fruitful application of "gravity-type" models than for other examples of spatial interaction such as telephone calls, commodity and traffic flows, in which *gross flows* are important, particularly in relation to linkage capacities. Most questions of practical import in mobility studies relate either to levels of population turnover or to the *net changes* which are a consequence of the *detailed* flow structure.

Although such changes are theoretically derivable from a structure such as that represented in Figure 9, our observational procedures are sufficiently weak that estimates of net flows derived from subtracting estimates of total outflow from estimates of total inflow are usually quite inaccurate.

A second characteristic of the model is that it does not directly incorporate competition for desirable vacancies between migrants nor does it reflect the range of selective and discriminatory practices in which owners and managers of residential property might engage. In other words, our model is predominantly demand rather than supply oriented.

There is still a substantial gap between the theoretical usefulness of the model and its realized utility. In general, we have to resort to other, predominantly descriptive, studies for insights into the detailed structure of flows. Several studies, for example, have noted the net suburbanization of households in the early stages of family formation (see Johnston, 1969, for example). There is a strong tendency for flows to be concentrated along the axis through the origin area from the city center, a phenomenon which both reflects (through the distribution of "suitable" vacancies within a given socio-economic class) and reinforces the sectoral pattern of socio-economic characteristics (Rees, 1970). Since the same phenomenon occurs for all socio-economic groups, this process also provides an explanation for the systematic variation of family-related demographic characteristics with distance from the city center. However, running counter to the net outward flow of young families is a smaller, though significant net inflow of young single adults breaking away from their families to form single-person households in the inner city (Butler et al., 1969).

Superimposed on these processes, which operate to maintain certain typical patterns of socio-economic and demographic variables, are more intensive and localized patterns of flow associated with changing neighborhoods. However, taking the racially changing neighborhood as an example, little appears to be known regarding the origins of blacks moving into the changing areas or the destinations of the whites moving out (except in the most general terms).

Many planning questions arise which demand better knowledge regarding destinations of movers and for which the model provides little insight. The destinations of those displaced in urban renewal projects or who abandon dilapidated structures in the inner city provide examples. In the former case, many households enter the market almost simultaneously such that it is virtually impossible to identify the set of vacancies which are available at that time; in fact, the unnatural pressure on the market often creates vacancies in the form of space in the homes of friends or relatives, which otherwise would not exist. The structure of the model is quite unsuited to such situations and any attempts to employ it might lead to serious social consequences (particularly by overestimating the ability of the market to absorb the sudden demand in a satisfactory fashion).

The main function of constructing a model of inter-area flows such as is found in equations (4) and (6) is to provide a reference-point for our thinking, a general structure which, as it is refined, will yield greater insights regarding the relation between change of residence and urban structure. However, as in the case of equation (1), the model relates to processes involving stability or gradual change in areal characteristics; for the short-term flows which result in rapid transition of neighborhood characteristics we must depend on developing more sensitive information systems rather than more sophisticated models of the type discussed in the previous pages.

C. In-Migrants to the City

Identification of the distribution of in-migrants to the city (the values m_n+1_j) poses a major problem in the analysis of residential mobility. In-migrants provide the infusion of new blood to the city, bringing new values as well as reinforcing the old. Their characteristics and distribution are of considerable importance as they form an additional element of competition for available vacancies and thus affect the outcomes of movement decisions of the city's resident population.

The classic ecological models of the Chicago School of Sociologists of the 1920's postulated a pattern of in-migration concentrated almost entirely in the center of the city and comprising mainly low-income households from rural areas with a large proportion of blacks. The pressure exerted by the continued influx of migrants into the city center produced an outward spread of population with the groups from the inner city invading immediately adjacent neighborhoods. Residents of the latter areas moved into the next outermost districts to be *succeeded* by the lower income groups from the inner city. The cycle repeated itself at increasing distances from the city center and thus the growth and change in the city population could be compared to the spread of a sand pile resulting from continually pouring fresh sand on the center of the heap.

Although a gross over-simplification, this model represented the main elements of in-migration to the large cities of the 1920's. To what extent has this pattern changed? In many cities, not only in the United States, the concentration of ethnic and racial minorities in inner city areas continues, but a greater proportion of *total* arrivals now go

directly to the suburbs. In London, the great majority of immigrants from overseas are to be found within five miles of the West End (Johnston, 1969). In the United States, as reported in the National Survey (Butler et al., 1969, p. 10), 61% of in-migrants to metropolitan areas go directly to the suburbs, whereas 90% of non-white immigrants go directly to the central city. In part this reflects the segregation of ethnic and racial groups, but it also reflects real socio-economic differences as most ethnic and racial minorities are in such a position that they can only locate in low-rent housing, most of which is to be found in the central city.

For the middle and upper-income migrant to the city, relatively little detailed knowledge is available regarding his location behavior. Some differences exist with respect to those wishing to rent and those seeking to buy homes, with the latter more likely to locate in the suburbs. If we pursue the notion that locational decisions are made on the basis of available information, it is likely that new immigrants will be constrained either by the location of friends and relatives[22] or by the job location of the head of the household. The latter applies particularly to middle and upper income migrants; in this situation, locational models based on accessibility to work are more likely to be effective than in the case of movers as a whole.

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[22] The friends and relatives model applies particularly well to members of ethnic minorities. Price (1964) shows that the attraction is highly specific in the sense that particular neighborhoods are identified not only with particular origin countries but with small regions within those countries.

A FINAL COMMENT

Perhaps the overwhelming impression gained from a study of residential mobility at both the individual and aggregate levels is the variety and complexity of functions it serves. In the case of the individual, movement might be forced upon him, or his decision may be voluntary. If he elects to move it may be as a consequence of the natural development of family needs or it may reflect severe stresses imposed on him by his physical and social environment. Separation of these various aspects of movement behavior is a major task: identification of both the magnitude and the context of different responses would be of considerable value within the practical realm of urban planning.

With regard to mobility experience at the scale of the neighborhood, we have seen that static, cross-sectional analyses are seldom fruitful unless related to some underlying theory of movement behavior. Unfortunately, our observational capabilities have not permitted us to do more than identify the most general patterns underlying residential mobility. The sudden change in neighborhood character, the decline in a once thriving shopping center, and the sudden increase in sale prices of city row houses often take us by surprise for we have not yet developed information systems sensitive to the early signs of rapid change. However, although they are of considerable significance such changes do not dominate the overall movement scene. For most cities, the main trends in the movement pattern are relatively well identified. The highest turnover rates are experienced in inner city districts with rooming-house and migrant transit areas often having rates in excess of 60% per annum. In most urban areas there is a net suburbanization of the resident population with Hoyt's notion of sectoral development supported by the sectoral orientation of movement flows. Inner suburbs are frequently characterized by an older population which experiences both an ageing effect as the children move away from the parental home and a gradual deterioration in the structures they occupy. If the former effect dominates we often find a decrease in population density in inner suburbs to increase again in some outer suburbs, whereas if the latter effect dominates we see a gradual decline in socio-economic status of the neighborhood.

Perhaps the greatest weakness in studies of residential mobility is the concentration on demand aspects of the movement process.[23] Often, it is not so much the existence of vacancies of a particular type which influence patterns of movement, but the degree to which population sub-groups with particular characteristics are permitted to occupy those vacancies by owners and managers of property. Although the case of the urban black provides the most dramatic case of constraints on movement possibilities, other groups are affected as well—many ethnic minorities, families with several children or even with children at all, and students. In as far as such discrimination creates a fragmented housing market with a marked territorial basis, the nature of these constraints must be incorporated within our studies of intra-urban mobility.

Whether present patterns of mobility will persist into the future is open for debate. The general mobility of society, the expanded horizons generated by the mass media certainly do not portend a reduction in the level of population movement. Despite intellectual concern for the continued spread of suburbia there seems to be little evidence of a change in values with respect to life styles which would reverse the net suburbanization of the urban population. Perhaps the most disturbing development is the increased abandonment of inner city structures. Brownsville, New York, is a ghost town, and it is estimated that 25% of the structures in the central city of St. Louis will be abandoned within five years. Instead of experiencing high turnover rates, these areas are experiencing high rates of net out-movement, with the majority of movers relocating in adjacent areas where the cycle begins afresh. If this trend continues unchecked (and much research needs to be done if appropriate action to stop this trend is to be identified) then the residential structure of our major cities will change more rapidly in the next decade than at any time in their past.

The basic theme of this paper is that residential mobility is not a variable to be isolated and examined by itself. It is embedded in the life histories of individuals and in the stability and change of urban neighborhoods; only in these contexts can mobility be fruitfully studied and interpreted.

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[23] The work of the North Carolina group (e.g., Kaiser and Weiss, 1970, is a major exception.

APPENDIX

Sources of Data for Mobility Studies

Data relating to intra-urban movements have always been difficult to acquire and the accuracy of available sources poses a continual problem. Three basic types of source can be recognized covering a great range both in spatial extent and in the degree of detail regarding specific households.

1) *National Census Data*

The decennial census provides the broadest spatial coverage of movement data in the sense of being available for all cities in the nation at one point in time. However, such data are at best crude for intra-urban studies. The 1940 Census of Population provided information on the place of residence in 1935 although the smallest unit for which data were presented was the county; the 1950 Census presented data on intra-county and inter-county moves for the previous year for both urban places and census tracts, while the 1960 Census both expanded the detail on destinations and extended the time period to five years, the questions relating to place of residence in 1955. In addition to the decennial Censuses, the Current Population Survey provides annual estimates of national and regional mobility rates based on a continuing sample of approximately 35,000 households.

The basic problems arising from the use of Census data in general for intra-urban studies are that the data ignore inter and intra-tract flows within the city and no account is made of multiple moves within the designated period prior to the Census. Furthermore, since it is usually prohibitively expensive to return to the original schedules it is impossible to tell which segments of the population are stable. Often the only practical approach is to relate profiles of population characteristics to movement characteristics of small areas, a procedure which can lead to spurious correlations. For example, Rossi (1955) has commented on the situation in which high mobility rates in inner city census tracts are consistently correlated with high proportions of single males: the conclusion that the single male has the highest movement rate is not necessarily justified, for the high proportion of single males may be merely an indicator of an undesirable environment for families with young children, the result being that it is the latter who have the high movement propensities.

2) *Special Directories*

A variety of sources are available which record changes of residence for individual households within the city. In Sweden, Holland, and Belgium, continuous population registers provide the most fruitful source for movement research, a factor which is strongly reflected in the mobility literature. Unfortunately, such registers do not exist in the United States, where the researcher must resort to less complete tabulations. These comprise directories compiled by commercial organizations (such as the Polk and Donnelly companies), electoral registers, school records, telephone directories, or public utility connection records. When available, the last named are probably the most reliable in the U.S. The basic difficulty in using these sources is that each is biased toward particular segments of the population, sometimes obvious as in the case of school records, and some not so obvious as in the case of public utility records which tend to be more reliable for homeowners than renters. In particular, most records are biased toward the more affluent, stable members of the community and all consistently understimate the total number of in-migrants and out-migrants, the error in the former usually being less serious than in the latter. A complicating factor is that the magnitude of the error is itself a spatial variable: if accurate descriptions of intra-urban movement rates are required, the effort must be made to evaluate the pattern of error values. (They are usually highest in inner-city rooming house areas, and under-recording tends to be greater for out-migrants than in-migrants.) Despite these difficulties, the special directory which is updated for other purposes is likely to provide the major source of movement data within the city for some time to come as the main costs are not imposed on the researcher; any other approach to the collection of movement data over time is prohibitively expensive.

3) *Special Surveys*

The evaluation of impacts of specific factors on the movement decisions of households possessing well-defined socio-economic and demographic characteristics is often

approached via large-scale, in-depth interview methods. A great deal of detail regarding each household's movement history, locational preferences and attitudes, and the environmental context of his decisions can be acquired. However, the procedure is both extremely costly and time-consuming: in addition, the demands on sample size are greatly magnified when locational attributes are used as a basis for classifying the population. For example, a sample of 2,000 interviews is large for most sociological purposes, but when 2,000 respondents are selected from 100 districts within the city each with an average population of 1,000, the degree of spatial analysis which can be pursued is very limited. Thus, at best, interview studies can only be used in a heuristic fashion at the present time in the construction of spatial models of intra-urban movement. Nevertheless, this contribution is of considerable value, for it is the only source of detailed insights into the behavior of the individual household.

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